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Making Packard Auto Castings-I

The Coreroom Extending Across the Center of the Foundry, but Not Partitioned Off, Supplies Cores for Both the Iron and Nonferrous Castings Departments

BY PAT DWYER

THE rapid growth of the automobile industry in recent years and the mass production of vast volumes of duplicate parts has led to the introduction of standardized methods at one time considered impracticable in the foundry field. Too much credit cannot be given the foundrymen engaged in this line of work for the resourcefulness and ingenuity displayed in solving the molding and casting problems presented by designers who were actuated solely by a desire to attain a maximum of strength and rigidity with a minimum of metal section. The intricacy of design resulting from a desire to assemble the complete operating parts in as few units as possible has taxed the ingenuity of the patternmaker, the molder, the coremaker and the metallurgist to the utmost.

The problem has been complicated further by the insistent demand for greater production and the corresponding necessity for adapting the methods within the scope of semiskilled help. It became necessary to design rigging that would insure the greatest degree of accuracy in the finished casting and yet be so simple and rugged that it could be made ready without incurring prohibitive machining expense and be strong enough to withstand the rough usage incident to any class of castings made on a production basis.

Many of the parts are plain and simple and only present one problem, that is to devise a method whereby they may be produced in the greatest numbers and as nearly in an automatic manner as possible. The composition of the metal entering into their construction is held within narrow limits. Their shape and size automatically eliminate

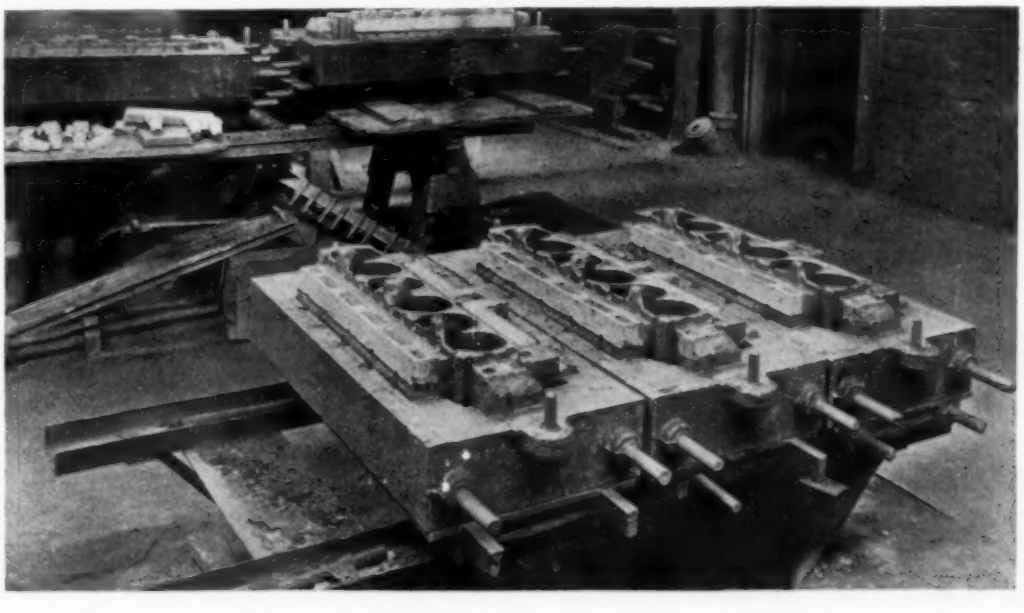


FIG. 1—AFTER THE CORES HAVE BEEN PASTED IN THE MOLDS THE FLASKS ARE LOADED ON RACKS AND PLACED BACK IN THE OVEN FOR ABOUT AN HOUR, TO DRY THE PASTE AND BLACKING—RECTANGULAR OPENINGS ARE PROVIDED IN THE LONG PRINT OF THE WATER JACKET CORE TO FACILITATE DRYING THE PASTE

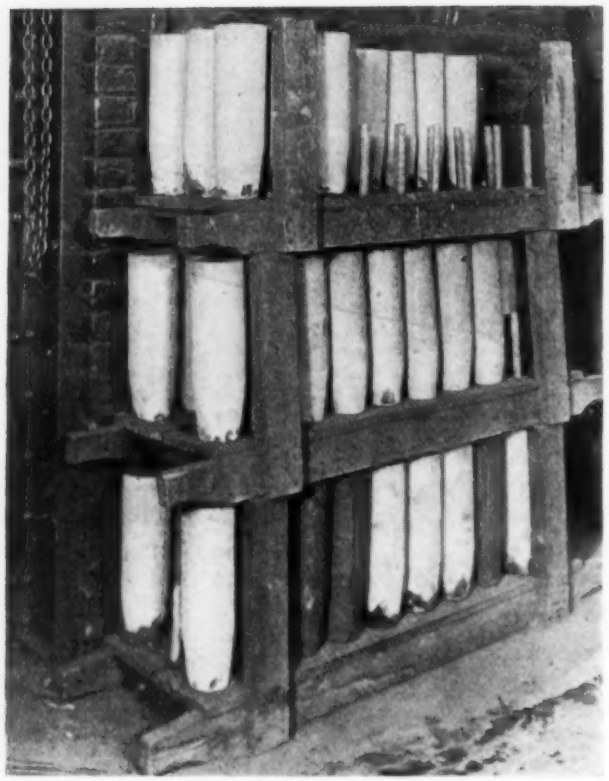


FIG. 2—BARREL CORES ARE RAMMED ON END FOUR AT A TIME IN A QUADRUPLE BOX—THEY ARE DRIED HORIZONTALLY, BUT AFTERWARD ARE STACKED ON HAND BARROWS AND CARRIED FROM PLACE TO PLACE—THE PEGS ON THE BOARD FIT IN THE VENT HOLES AND PREVENT THE CORES FROM WABBLING

many of the factors through which other castings may be condemned, shifted cores, cold shuts, shrinkage, drops, blows, scabs, etc. They are particularly adapted to green sand snap flask molding either on the bench or on one of the many types of molding machines available. Usually by the exercise of a little ingenuity the patterns may be made to leave all their own cores, or if such construction should appear uneconomical, it may be advisable to attach a core print and by the addition of a trifling cost to the core room, effect a considerable saving in the entire cost of the job.

Green and Dry Sand

Castings of intricate shape, minimum metal thickness and which must conform to rigid specifications such as cylinders, cylinder heads and crank cases, present so many angles for consideration that it is no wonder up to the present no one universal method has been adopted for their production. In America by far the greater bulk of automobile cylinders are cast with the barrels lying horizontally in greensand molds. European practice favors dry sand molds with the barrels cast vertically. In American foundries where the castings are made in dry-sand molds, the barrels also are cast in a vertical position.

On account of the peculiar shape and of the *feather edges* involved at certain points it is not practicable to mold an automobile cylinder in green sand with the barrels in a vertical position. It becomes necessary either to make the mold in dry sand enclosed in an iron flask, or to form the entire mold from a core sand mixture. In either case the mold is made up of a drag, a cheek and a cope. Up to the present with the exception noted in THE FOUNDRY page 861 Nov. 1, 1920, describing how the Ferro Foundry & Machine Co., Cleveland makes both cores and mold horizontally for the Chevrolet cylinder in green sand, all the cores used in automobile cylinders whether made in green or dry sand molds, are made from core sand mixtures and dried before they are placed in the molds.

Theoretically, a dried mold is an insurance against any of the features responsible for defective castings, but no comparative figures are available to show whether or not the extra number of castings saved through drying the molds offsets the extra cost involved in preparing the molds in that manner. The price of new sand including freight may be an important factor in deciding whether the molds shall be made in green or dry sand, particularly if the sand must be hauled a considerable distance. At least one prominent foundry in the Middle West has changed from a core-sand mixture to green sand molds within the past year owing primarily to the prohibitive freight rates on new sand.

Matter of Personal Opinion

No foundryman of experience will deny that cylinder castings, or for that matter almost any other kind of castings, may be made in green-sand molds. In fact, for certain classes of castings, green-sand molds are preferable to any

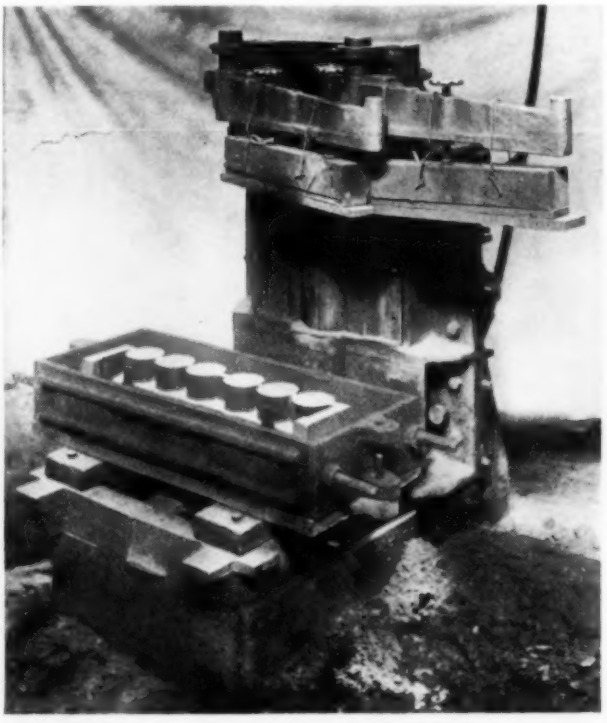


FIG. 3—THE CHEEK SECTION OF THE PATTERN IS THE EXACT DEPTH OF THE FLASK IN WHICH IT IS MOLDED—THE CHEEK IS ROLLED OVER AND DRIED AND THEN ROLLED BACK AGAIN BEFOR THE MOLD IS ASSEMBLED

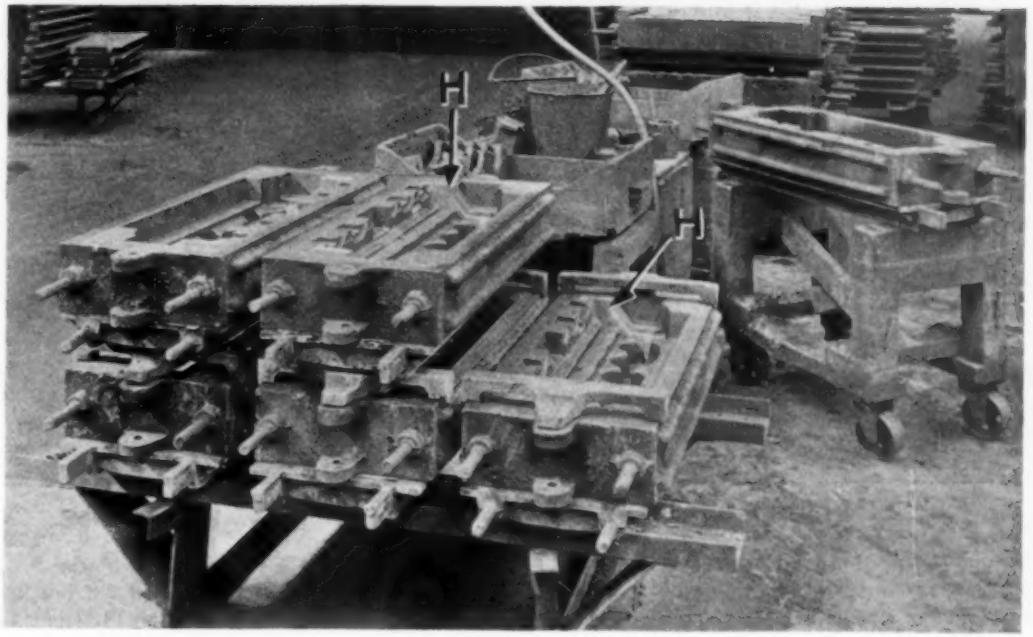


FIG. 4—THE FLAT END CORES SHOWN AT *H* ARE PLACED IN BOTH ENDS OF EACH CHEEK BEFORE IT IS BLACKED TO GO INTO THE OVEN

other; but, and this is the main objection, a great deal more care and expert supervision is required to maintain a daily capacity schedule on green sand molds than on those that are dried. The main consideration and the one that requires the closest and most constant attention is to provide sand that has been properly tempered. The methods introduced and practiced during the past five years at the plant of the Packard Motor Car Co., Detroit under the direction of the foundry manager, Fred Erb, afforded an interesting commentary on the application of green and dry sand molds and cores. Mr. Erb has developed an ingenious rigging having for its object the successful production of the greater part of his castings in green sand molds, but he insists on making his cylinders in dry sand and claims that he has figures to prove it is the best method. After briefly considering the foundry as a whole a detailed description of the methods and rigging employed in the production of a few typical castings may be of interest.

Forms Complete Unit

The foundry department of the Packard plant forms a complete unit in itself and is located on part of the company's property at some distance from the other buildings comprising the manufacturing plant. The foundry proper 100 x 627 feet, or that part devoted to the preparation and pouring of the molds, is enclosed between two brick walls extending the entire length of the building. Each of the walls is provided with several large doors opening into adjoining divisions but the walls have no windows. Light is furnished through the end walls made up almost entirely of window sash and also through the roof made up of a series of inverted V-shaped ridges extending transversely across the building, generally known as the saw-tooth type.

The steel frame, supporting the roof, is comparatively light, but the truss form of construction renders it sufficiently rigid to support a 1-ton hoist over any of the floors. Owing to the character of the work, it has not been considered necessary to erect a crane runway along the walls capable of supporting a heavy electric traveling crane, but instead light easy-running cranes supplied with chain

FIG. 5—DRAG MOLDS ARE LOADED ON RACKS FOUR DEEP, THREE IN A ROW AND PLACED IN THE OVENS TO DRY

FIG. 6—THE WATER-CHAMBER CORE IN THE CYLINDER HEAD IS SUPPORTED BY FOUR PRINTS ON EACH SIDE AND IS PREVENTED FROM RISING BY FIVE RADIATOR CHAPLETS AND A SHOULDER ON THE PUMP CHAMBER CORE ON THE END

blocks and mounted on rails suspended from the roof trusses are installed over those floors on which the loads are too heavy to be lifted and transported by hand. A monorail, supported by brackets attached to the wall columns on either side and a number of automatic lift trucks serve to facilitate the conveying of materials from one point to another. This feature will be touched upon more in detail later.

The molding floor is laid out transversely into three main and approximately equal divisions. Iron castings are made in the first, cores are made in the second or middle division and the third is devoted altogether to the production of brass and aluminum castings. Occasionally men, material, or flasks may be transferred from one section to another depending on the relative tonnage of orders in each division, but usually the sections are operated as separate, self-contained units.

The department to the east of the molding and casting department and separated therefrom by the brick wall already referred to, comprises at one end an iron-casting cleaning department, equipped with the necessary appliances; a similar room at the other end in which all the nonferrous castings are cleaned and a 2-story structure in the center. The foundry office, together with an extensive wash and locker room are located on the ground floor in the center section and the upper floor is devoted to the manufacture and storage of both wood and metal patterns.

The 44 x 176-foot pattern shop partly shown in Fig. 8 is fully equipped with metal and woodworking power tools. They are arranged as nearly as possible in a straight line down the center of the shop and are driven from one continuous line shaft.. The safety first and accident prevention policy of the management is exemplified in a striking manner in the pattern shop where every machine is surrounded as far as possible by a protective device of some character. A typical example may be seen in Fig. 8 where the belts and pulleys of the band saw are protected by a pipe railing and the upper and lower saw wheels enclosed by heavy wire-screen guards.

The pattern layouts are made on sheet aluminum thereby giving a durable working drawing. In addition to the new pat-

FIG. 7—MACHINERY IN THE PATTERN SHOP IS ADEQUATELY GUARDED TO PREVENT INJURY TO THE WORKMEN USING IT

terns incident to changes in design and methods of production emanating from the main office, a certain amount of experimental work giving tangible shape to the ingenious ideas of Mr. Erb, usually is in progress. Duplicate metal flasks, plates, etc., are finished in one of the regular machine shops, but the first flask and the first piece of rigging for every job, is made in the pattern shop where it may be tested and tried out under actual operating conditions.

The pattern-shop office, containing among other things blueprint, filing and record cabinets, is located between the pattern shop and the pattern storage. A card index corresponding to the manner in which the rows of shelves are laid out and erected on the pattern storage floor furnishes a ready means of finding any given pattern at any time. The shelves for supporting the patterns in the various sections are made of heavy wire screen and therefore do not catch or hold dust. Snap flask metal matchplates are placed on edge on the shelves set apart for that purpose. They are held in position by small grooved castings attached to the shelf immediately above each group.

Material Storage

A covered roadway, lighted through windows in the roof, extends along the exterior of the west wall of the foundry. It furnishes communication with a row of concrete bins built parallel with the foundry wall and used for storing practically all the bulk material employed in the daily routine. This material is grouped as nearly as possible opposite that part of the foundry in which it is to be used. Thus the virgin metal shop scrap and nonferrous scrap from the machine shops are stored in bins close to the battery of oil-fired furnaces which serve the molding floors at one end of the shop where the nonferrous castings are made.

Molding sand comes next, then Michigan City and Bridgeport, bank sand to supply the coreroom. Zanesville and red top sand are stored in the bins opposite the iron molding floors and the remaining bins are filled with pig iron and scrap. The latter is only temporary to serve until a large elevated platform at present located outside one of the three cupolas shall have been extended to serve the other two. The bridge of a 15-ton gantry crane made by the Wellman-Seaver-Morgan Co., Cleveland, extends over the track on which the pig iron arrives. This can be employed to lift the pig iron directly to the platform built to sustain several hundred tons; or to pile it on the ground in the immediate vicinity. At present a locomotive crane, equipped with a magnet is employed to transfer the pig iron from the cars either to the bins through holes in the roof or to piles on the ground. The Packard foundry has a daily melting capacity of approximately 85 tons of iron, 10 tons of brass and 20 tons of aluminum, but in common with the casting industry in general has been operating on a considerably reduced schedule some time.

One of the cupolas lined to 42 inches usually melts all the iron required during this period of depression. The charges are made up uniformly at 1000 pounds each, but vary to a certain extent in the relative proportion of their component parts. A typical charge for the cylinder floors is made up of 20 to 25 per cent high silicon low phos southern pig iron; 20 to 25 per cent bessemer pig iron; 25 per cent steel scrap and 25 to 35 per cent remelt. This is not an arbitrary mixture and may be varied from day to day depending on the character of the scrap available. Eight

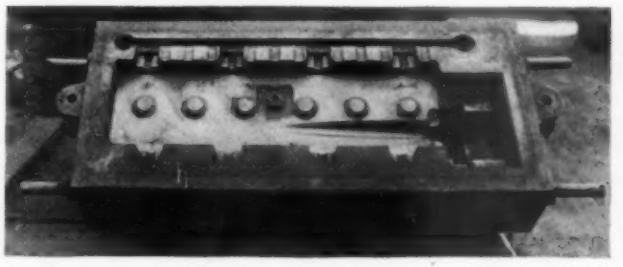


FIG. 8—THE CYLINDER HEAD CASTING PRACTICALLY ALL IS MADE IN THE COPE

forkfulls of coke, equivalent to about 170 pounds, are spread between consecutive charges of iron. This works out at a coke to iron ratio (exclusive of the bed) of about 1 to 6. The iron for automobile castings in some cases must be carried a considerable distance and in all cases must be poured exceedingly hot and fluid. Both these conditions are met in a gratifying manner by the method of charging outlined. The blast pressure is held between 10 and 12 ounces and a shovelfull of limestone is spread on every charge. The average analysis of cylinders cast in this shop follows:

Total carbon, 3-3.10 per cent.
Combined carbon, 0.40 per cent.
Silicon, 2.75 per cent.
Sulphur, 0.08 per cent.
Phosphorus, 0.20 per cent.
Manganese, 0.50 to 0.60 per cent.

None of the castings made in the foundry weigh more than 200 pounds and for that reason it is customary to pour them either with single hand ladles in the case of the bench work, or with one or two double shank ladles for the remainder. For instance, the cylinders and cylinder heads are gated to be poured with two ladles, while the transmission cases and flywheels and other parts are gated to be poured with one ladle. The iron is tapped into a 1500-pound ladle suspended from a monorail which extends to the end of the shop. Several of these ladles are provided and are employed to convey the iron to the distant floors. However, the greater part of the iron is carried away from the mixer ladle while it remains under the spout.

Coke Fired Ovens

Twenty ovens 6 x 6 x 10 feet, built by Holcroft & Co., Detroit, serve to dry both the cores and the molds. They are arranged in a line inside and adjacent to the west wall of the foundry building and are disposed in groups of four for convenience in heating. The fireplaces for each group of ovens are located in a large underground chamber and the heat from the fire enters the ovens through a number of holes in the upper side of a large flue extending from end to end, under the floor of each group. Suitable dampers are provided so that the amount of heat entering each oven may be regulated. In like manner, dampers are provided in the upper wall openings leading to the chimney. The upper passages are left open until the greater part of the water has been evaporated from a batch of green cores or molds. Then they are closed and under ordinary routine conditions remain closed until the cores are dried.

Coke for the oven fires is brought in by wheelbarrow and dumped through a manhole in the floor. A small, hand operated winch provided with a swinging jib, which can be pushed to one side out of the way when not in use, is employed for removing the ashes. A round, sheet-iron container about 2 feet high and 1½ feet in diameter, provided with a bail, is lowered into the firing chamber, filled with ashes and then hoisted through the manhole and dumped into a wheelbarrow. Iron covers are laid over the manholes when not in use and also over the hatchway through which the fireman enters and leaves the firechamber.

The coreroom including the ovens oc-

(*Concluded on Page* 155)

Death of Henry Alden Carpenter

HENRY ALDEN CARPENTER, known throughout the foundry world as an able executive and ardent worker in the technical and business organizations of the industry, died at his home in Providence, R. I., Jan. 29, aged 55 years. Combining in his personality those attributes of high character, genial and kindly manners, and a profound appreciation of humanity, he made and held friends throughout his active life. He was a distinguished host, an able business executive and an effective and popular speaker. Mr. Carpenter was born in Providence, July 7, 1867. Following a public school education, he entered the offices of the Providence National Worsted Mills, where he was employed until he entered the foundry business with his father and brother, William Carpenter, in 1889, as vice president and treasurer of the firm of Alva Carpenter & Sons Foundry Co. The Carpenter foundry executed a great amount of work for the first established fire extinguisher company and finally was merged into the General Fire Extinguisher Co. organization. By rapid successive steps, Mr. Carpenter became manager of the five foundries of the company, plant manager of the Auburn, R. I. works, member of the executive board, publicity and promotion manager and director. At the time of his death he was a director, publicity manager and foundry manager for the entire company, which operates plants in Auburn, R. I., Charlotte, N. C., Atlanta, Ga., Warren, O., and Toronto, Ont.

During the past few years, Mr. Carpenter actively supervised the construction of the extensive and modern plants built at the two cities last mentioned. The stamp of his judgment, developed through over thirty years foundry experience, is carried by both of these institutions and many of the excellent features of design are credited to his advice.

Mr. Carpenter's interest in the technical advancement of the foundry industry are best evidenced by his work in the local and national organizations. His name and the name of his brother William, appear on the registration list of the organization meeting of the American Foundrymen's association held in Philadelphia in 1896. From that time forward he was identified with that society, being elected vice president in 1905. From 1913 to 1920 he was almost continually either vice president or director of the association and for business reasons declined the presidency which might have been his.

The National Founder's association and the New England Foundrymen's association, also, honored Mr. Carpenter for his activity by appointing him to various offices. He was a past-president of both organizations. Locally, Mr. Carpenter assumed an active leadership in civic and community affairs. Between 1905 and 1907 he was a member of the Providence city council. He was identified with the formation of the chamber of commerce of his home city and through his organizing ability he brought it to a position of strength and respect. During the war, Mr. Carpenter was chairman of the war council of the chamber of commerce, an organization which co-ordinated the efforts of the various clubs, relief organizations and local governmental committees. His standing in local business affairs is shown by his directorships in the Union Trust Co. and the Rhode Island Insurance Co.

HENRY ALDEN CARPENTER

Tunnel Segment Casting Methods

Many Factors Besides Those Usually Connected with the Production of Castings Confront the Manufacturer Who Undertakes To Make the Cast-Iron Lining for the Vehicular Tunnel Under the Hudson

DIFFERENCE of opinion between consulting engineers regarding the type of tunnel that best would meet requirements and, in a secondary measure the most suitable kind of material to employ, halted for over a year the preliminary work on the proposed vehicular tunnel under the Hudson river connecting the lower end of Manhattan island with Jersey City. Eleven tentative schemes were given consideration by the New York bridge and tunnel commission before a plan finally was adopted. Excavation was to have started on the New York side in February, 1921, and the vertical shaft, 60 feet deep, from which the tunnel was to be driven was to have been completed in October of the same year. Progress in the inauguration of the great project has been held up until recently by a dispute between the New York and New Jersey commissions. The New Jersey commission held that the widening of the streets in Jersey City at the New Jersey end of the tunnel constituted a part of the work of building the tunnel, while the New York authorities held that the cost of widening these streets is something that properly should be assessed locally in Jersey City.

An agreement finally has been reached and as a result the commission advertised for bids on the different contracts to be opened on Feb. 7, 1922. A few large eastern foundry interests have submitted prices to some of the more important contractors who submitted bids on the general contracts on that date.

A cross section of the proposed twin tunnel is shown in Fig. 1. The two tubes are laid parallel and, in accordance with war department restrictions, the upper side is 50 feet below mean low water. The tubes will lie 15 feet apart. This type of tunnel was adopted in preference to several others including, a double deck tunnel 42 feet in diameter built of concrete blocks; a precast reinforced concrete tunnel; a concrete tunnel with steel shield and outer coating of concrete placed by the triemen method; and cast iron tunnels larger and smaller than the one finally adopted.

Extent of Traffic

It is estimated that the yearly tunnel traffic based upon 340 days a year will amount to 5,610,000 vehicles in 1924, or about equal to the traffic over the Williamsburg bridge at the present time and that by 1934 this will have increased to 12,900,000. It also is predicted that in 11 years after the tubes are completed they will have yielded in operating revenue a sum sufficient to amortize the construction cost and that in 20 years a surplus of $66,500,000 will have been produced. Further interesting figures in this connection are to the effect that the total construction cost will amount to $28,669,000 and the total time consumed in construction work will be 3½ years. The mean length of the cast iron rings is 7345 feet and the total length of the tunnel, including the approaches, is 9300 feet. Each tube carries a 20-foot roadway for two lines of vehicles, but both lines in each tube move in the same direction. Thus the north tube will be devoted to west bound traffic from New York to Jersey City and the traffic in the south tunnel will move from Jersey City to New York. The construction and operating cost and later, the revenue, will be shared equally by New York and New Jersey.

The 29-foot cast-iron tubes recommended follow standard practice as exemplified in tunnels already installed under both the East river and the Hudson. They are larger than any heretofore constructed, but that is approximately the only difference. They are to be constructed by bolting together successive cast iron rings 2 feet 6 inches wide. Each ring is made up of 14 segments 77.672 inches long on the outside circumference and a

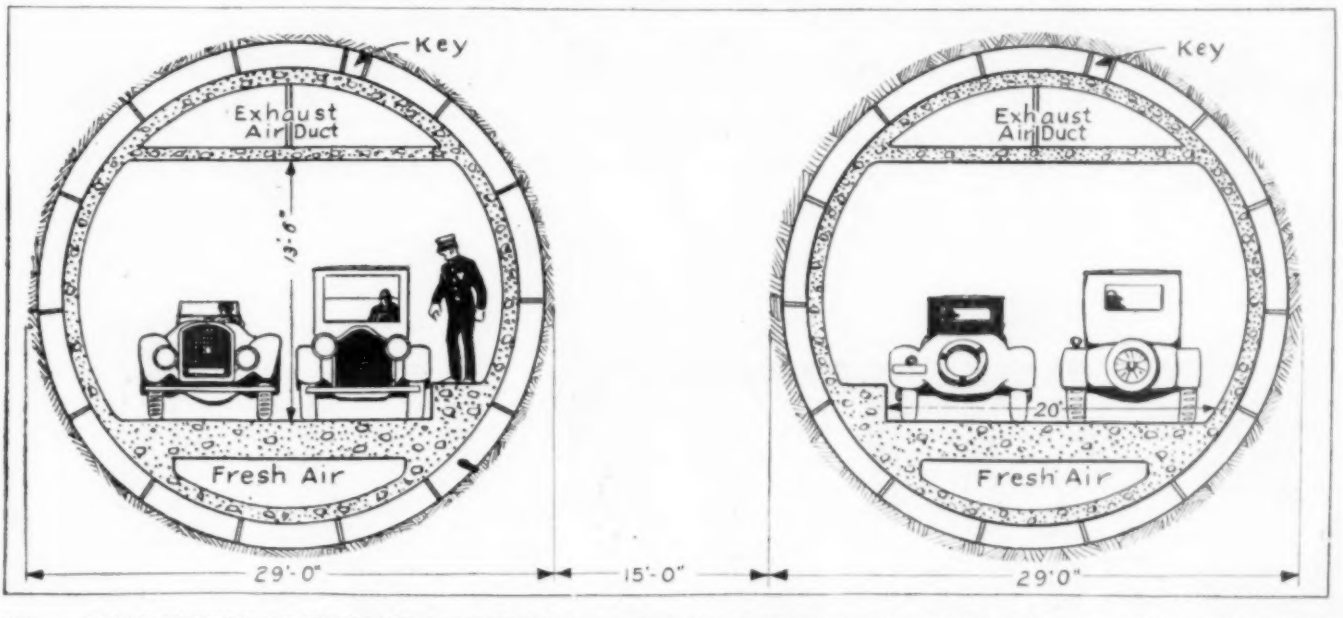


FIG. 1—CROSS SECTION OF PROPOSED VEHICULAR TWIN TUNNEL UNDER THE HUDSON RIVER—APPROXIMATELY 115,000 TONS OF CAST IRON SEGMENTS WILL BE EMPLOYED TO FORM THE CASING 29 FEET DIAMETER BY 7345 FEET LONG—TOTAL LENGTH OF THE TUNNEL WITH APPROACHES WILL BE ALMOST 2 MILES

key segment 11.868 inches long. Provision is made in each complete ring for 85 1¾-inch bolts on the circumferential joint and for 75 similar bolts on the horizontal joint.

The weight of the cast iron lining at the points where it passes through sand, earth and rock excavations is specified at 8 tons per linear foot. Where it passes through silt and mud and, therefore, requires to be heavier to compensate for displacement buoyancy, the specifications call for 8½ tons per linear foot. This feature will be taken care of in the foundry by increasing the thickness of metal in the back of the castings from 1⅞ to 2 inches. Cement grouting fed through a hole provided in each ring for the purpose, will be employed to fill the space between the exterior of the ring and the excavation made by the boring shield. The interior of the tunnel will be lined with concrete to a thickness of 19 inches, or 7 inches beyond the flanges on the cast iron ring. The finish on the face of the lining will be of such a character

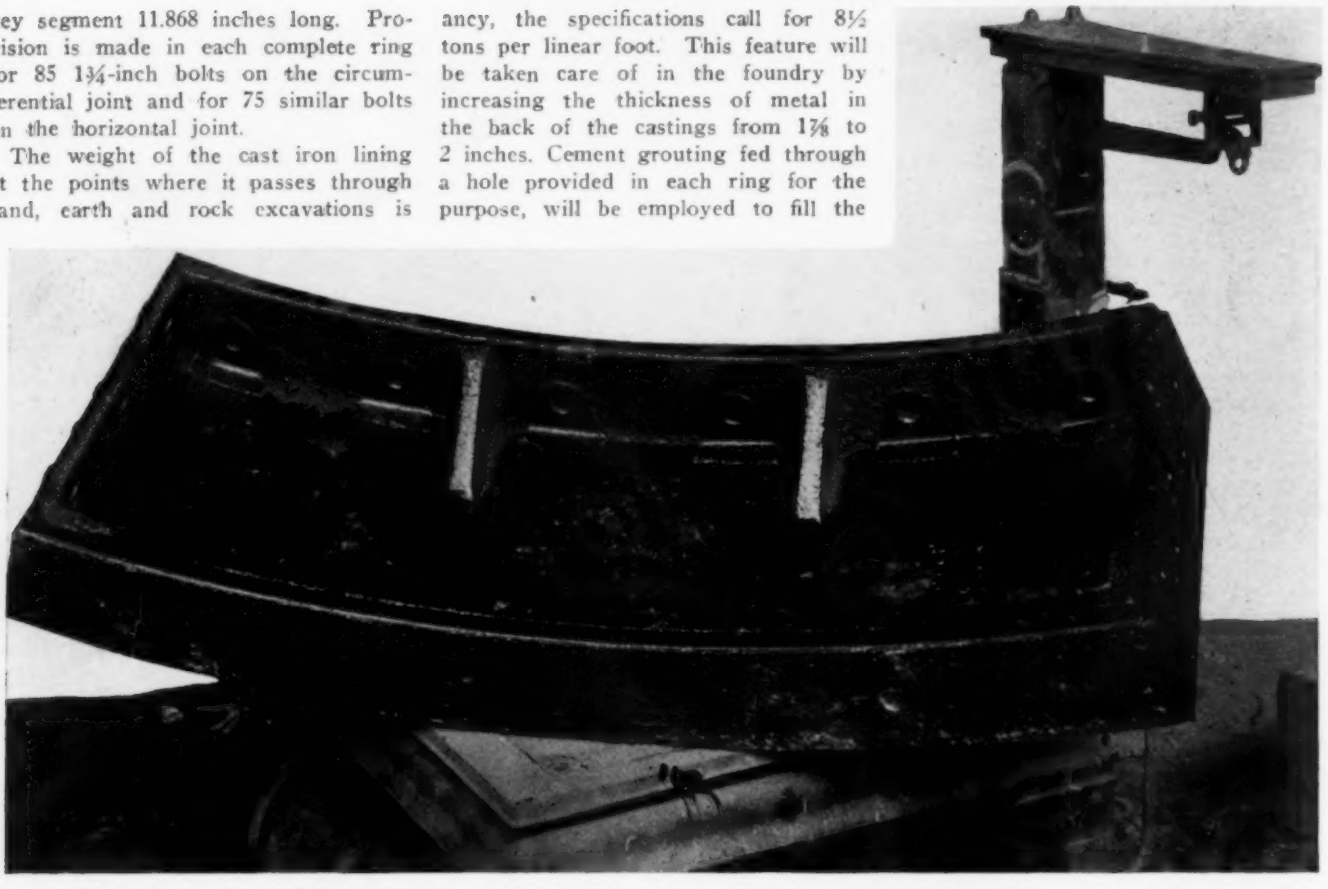


FIG. 2—ABOUT 82,300 OF THESE CASTINGS, 6½ X 2½ FEET AND ALMOST 6000 KEY SEGMENTS 1 FOOT WIDE WILL BE REQUIRED TO FORM THE CASING FOR THE TWIN TUBES

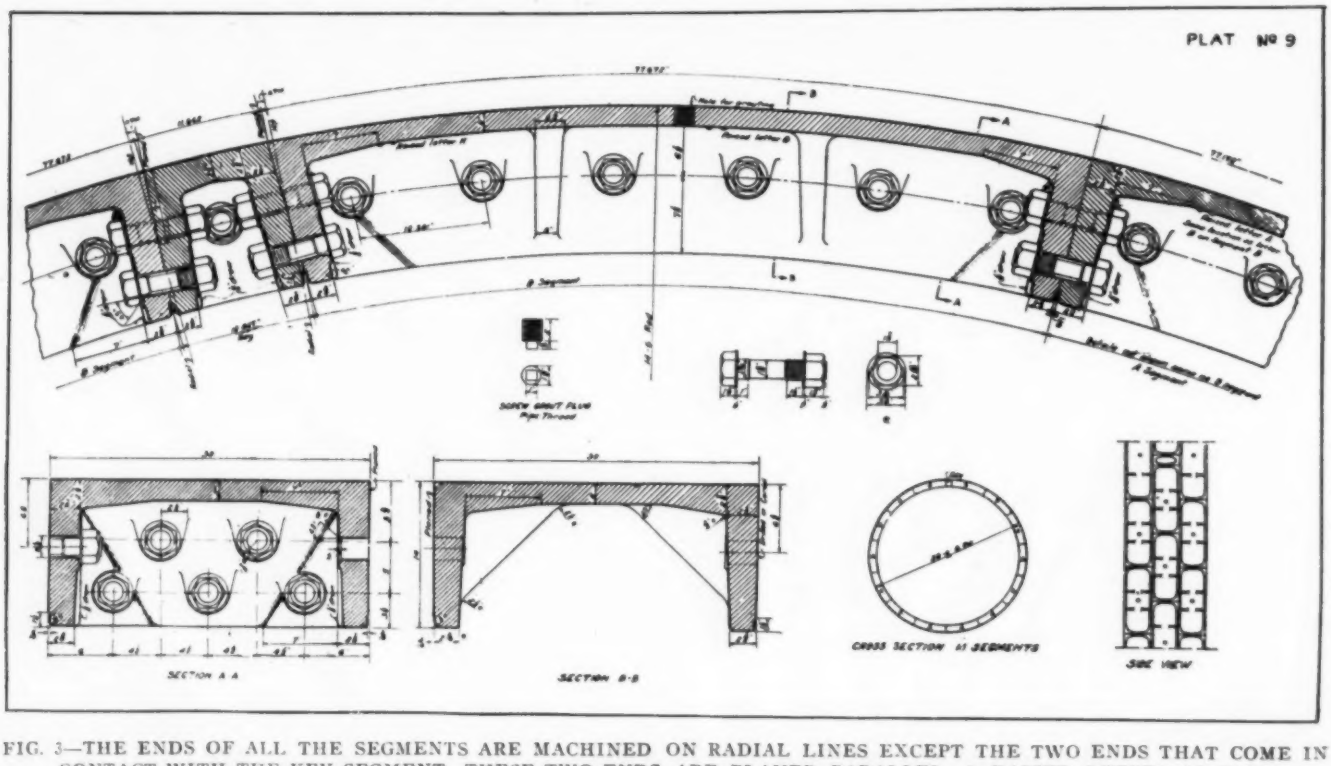


FIG. 3—THE ENDS OF ALL THE SEGMENTS ARE MACHINED ON RADIAL LINES EXCEPT THE TWO ENDS THAT COME IN CONTACT WITH THE KEY SEGMENT—THESE TWO ENDS ARE PLANED PARALLEL—A RAISED LETTER IS CAST ON EACH SEGMENT TO FACILITATE ASSEMBLING IN THE FIELD

that it easily may be kept clean. Glazed tiling was considered for the purpose, but on account of the cost element was not adopted.

Pipes for draining and ducts for power and telephone wires are to be embedded in the concrete lining. The 20-foot roadway, with a 6-inch pavement laid on concrete and steel beams, is provided with a sidewalk at one side 6 inches back from the curb and 26 inches above the pavement. A fresh air chamber, connected to the tunnel through suitable openings, extends the full length under the roadway and a similar chamber for removing vitiated air and noxious fumes from the automobiles, extends above the roadway. Statistics supplied by truck manufacturers and users, indicated 12 feet 8 inches as the extreme height to which a truck might be loaded and the tunnel designers feel that in providing head room of 13 feet 6 inches the margin of safety is sufficient to take care of any contingency.

Approximately 115,000 tons of segment tunnel castings will be required for the two tubes, 82,264 duplicate castings like that shown in Fig. 2 and 5876 narrow key segments, a total of 88,140 segments altogether. In addition to the segments, numerous other castings will be required in connection with the drainage, ventilation and electric light systems as well as for other purposes. The tonnage for these miscellaneous castings will be considerable, but it will be only a fraction of the segment requirements. About 4000 tons of 1¼-inch bolts will be used in bolting the segments together. Structural steel will be used for the approaches, shafts and tunnel to the extent of 12,000 tons and about 3000 tons of reinforcing steel will be used to supplement the concrete construction. About 250,000 barrels of cement and 1000 to 2000 tons of cast iron, wrought iron and steel pipe will be utilized.

Delivery of castings, which does not commence until after the preliminary work at the terminals has been completed, will extend over a period of two years, or at the rate of approximately 133 segments amounting to 200 tons a day.

In the early days of segment casting, that is to say when previous tunnels were built in 1905 and several years thereafter, the molds were rammed by hand in flasks with the joint cut to conform to the curve of the casting. The pattern was mounted on a follow board and the cope was rammed directly on top of the drag. After a while a dummy board was provided on which to ram the copes and in this manner production was increased to a considerable extent by having one gang of men ramming drags and a second gang ramming copes. Within the past few years, foundries handling this class of castings have installed molding machines and sand-handling equipment and have increased their facilities for turning out tunnel segments to an appreciable extent. One large foundry in Pennsylvania which had attained an output of 125 tons a day under the hand molding method turned out tunnel castings on its latest contract a few years ago at the rate of 175 tons a day.

On account of the large daily tonnage involved and other features of a limiting character, comparatively few foundries were able to tender on these castings. A large number of special accurately fitted and interchangeable flasks are required; extensive floor room is needed for molding, pouring and shaking out; special sand handling equipment is necessary to supplement the improved molding equipment; cupola capacity must be ample and yet

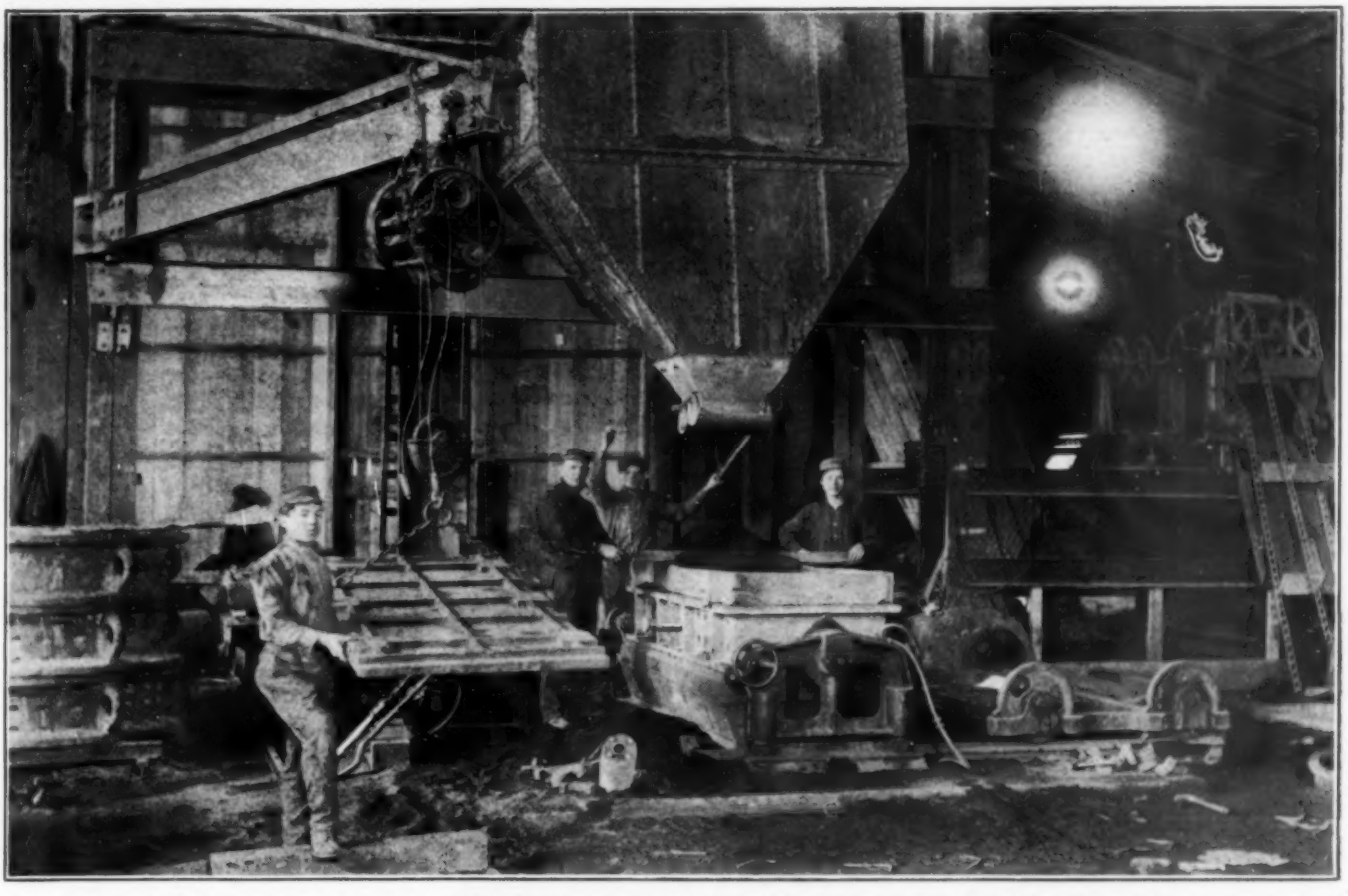


FIG. 4—THE SAND IS MIXED IN THE MECHANISM AT THE RIGHT OF THE ILLUSTRATION AND CONVEYED TO THE HOPPER IN THE CENTER FROM WHICH IT FLOWS THROUGH A HAND OPERATED GATE INTO THE DRAG —THE DRAG IS RAMMED ON A ROLLOVER, JOLT MACHINE

arranged in such a manner that the iron can be distributed among the many molds without confusion. Another factor having a direct bearing on the subject lies in the fact that the segments are machined along both sides and across both ends and therefore it practically is essential that the foundry undertaking the work is operated in connection with a machine shop equipped in a special manner for performing the necessary operations. The manner in which these castings were molded in the foundry of the Wheeling Mold & Foundry Co., Wheeling, W. Va., for a recent installation, is shown in the accompanying illustrations and the description of the machine shop methods for handling similar castings made in its own foundry are taken from an article published in THE FOUNDRY, April, 1916, covering the Davies & Thomas plant, Catasauqua, Pa.

Plain Flasks Used

A method which is an exception to the general rule is shown in Figs. 4, 5 and 6 where plain flasks are employed instead of those having their joints cut to conform to the curve of the pattern. By referring to Fig. 6, it may be noted that a special parting has been devised with the center above and with the ends below the joint of the flask. The advantage of this type of construction is that the flasks may be used for making other castings when no tunnel segment contract is in hand.

The drag machine and cope machine are placed reasonably close together so that they may be served from the one sand pile. The sand handling equipment and method of forming the drag part of the mold are shown in considerable detail in Fig. 4. The sand is cut over into a pile from which it is taken by a bucket elevator and dumped into a revolving screen through which it passes into a pit served by a second elevator. The second elevator supplies a hopper suspended over the flask on the molding machine. The hopper is provided with a hand controlled gate at the bottom through which the proper amount of sand is allowed to flow into the flask. A 6-inch frame on top of the flask holds enough extra sand to compensate for the shrinkage due to ramming. On account of the enclosed body of sand between the two sides and the two ends of the pattern it is necessary to vent the drag well before it is rolled over. The drag is rammed on a direct-draw, rollover, jolt machine.

The cope part of the mold is rammed upon a plain jolt machine as illustrated. It is not rolled over, but lifted from the machine and placed on the drag. The cope is filled with sand from a grab bucket suspended from the crane. In an emergency the hopper over the drag machine may be filled with sand in the same manner.

No attempt is made to secure a smooth skin on the castings. Both sides and both ends are machined all over and since the interior eventually is to be filled with concrete a clean, smooth skin is not essential. A small proportion of new sand is added to the heap occasionally to keep it alive and this heap sand is used to cover the pattern and fill the flask. Both wood and metal patterns have been used in making tunnel segments and it has been found that well constructed hardwood patterns give satisfactory service. Where the pattern is attached to a plate mounted on a molding machine of large lifting capacity, a metal pattern is preferable, since it never will need repairs; but on lighter machines and in those instances where the flasks are rammed by hand the wooden pattern is the more convenient form.

Dry Sand End Cores

A generous amount of draft is allowed on the side flanges of the pattern both inside and outside and also on the two brackets on each side of the interior. The exterior of the end flanges, cut on radial lines, are ideal for drawing out of the sand, but the interior surfaces of the same flanges present a problem. When the pattern is rammed in the drag it is apparent that the body of sand inside the pattern overlaps the ends to such an extent that the pattern cannot be drawn vertically. A feature that further complicates the problem is that it is necessary to set five 2-inch cores staggered across each end. Two solutions are open. One is to make the ends of the pattern loose and draw them either before or after the main pattern. Tail prints on the outside would locate the cores. This method could be adopted with a metal pattern, but with a wood pattern it would weaken the construction.

The second method and the one usually followed, is to attach a tapered core print to the inside of the end flange. This print extends all the way across the pattern and is tapered at the back in the opposite direction from the flange so that it will draw easily with the pattern. The core designed to fill this print carries the five, 2-inch cores and thus all the cores are located at one setting. Another advantage of this method is that the dry sand core across the end protects the green sand from the force of the incoming stream of iron. The casting is poured at one end through a gate in each flange. By referring to Fig. 2 it will be noted that the tail prints on the side cores are unusually

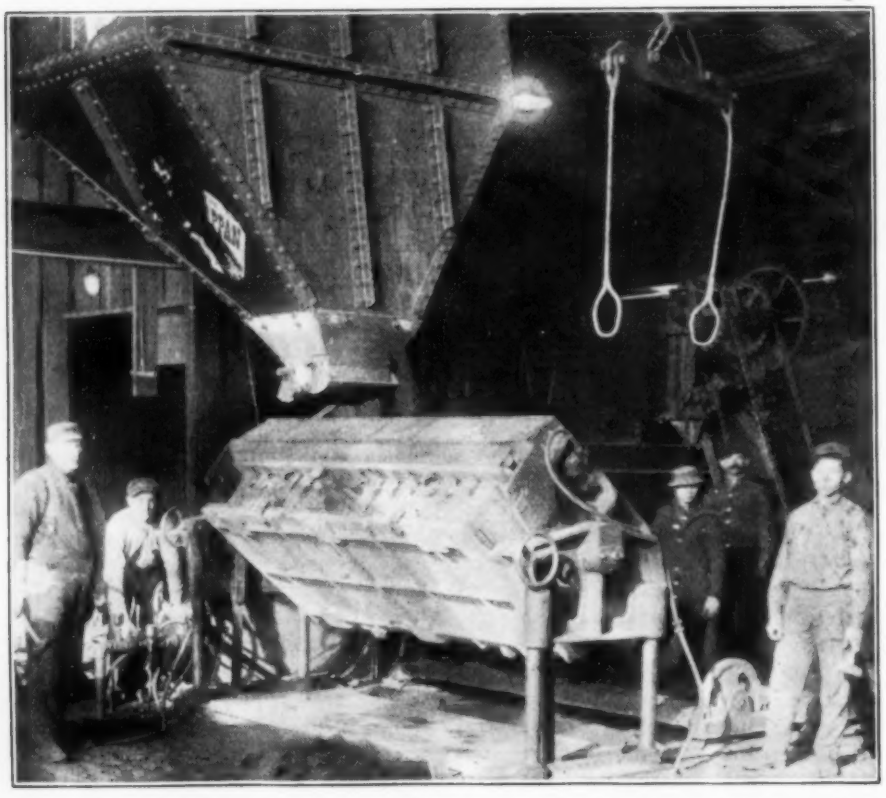


FIG. 5—THE SAND HOPPER IS SO ARRANGED THAT IT DOES NOT INTERFERE WITH THE DRAG WHILE IT IS ROLLED OVER

wide. By adopting this arrangement the core prints are attached permanently to the pattern, the cores all are exactly alike and can be made in unlimited quantities without getting them mixed.

If the tail prints were made just 2 inches wide, the same as the bolt core, it would be necessary either to make them loose, attach them in place each time the drag was rammed and remove them after the pattern was drawn, or to provide three different coreboxes to fit the three differnt peaks on the tops of the tail prints. It would be necessary to provide six coreboxes only for the fact that the three cores in one end of the right hand side will fit in three prints on the opposite end of the left hand side. Both of these objectionable features have been avoided by the construction shown. The prints are attached permanently on radial lines so that one style core fits them all and the extreme taper on the sides permits the pattern to be drawn vertically. In addition to forming the bolt holes, the cores both on the sides and on the ends form slightly raised bosses on the surface so that the bolts may be drawn down solidly. The five bolt cores attached to the end core are spaced evenly from a center line and, therefore, the same core fits either end. On account of the extremely hard usage to which they are subjected all the coreboxes are made of metal. The side cores are made in multiple boxes either on the bench or on small hand bumping machines. The large end cores are rammed one at a time, usually by hand; but the plain open shape lends itself readily to the employment of a small jar-ram machine and this method has been employed extensively on recent contracts.

The Davies & Thomas Co., Catasauqua, Pa., performed the necessary machine shop operations in two buildings 55 x 160 and 55 x 111 feet respectively equipped with heavy machinery of special design to meet the peculiar requirements. A 42-foot Ingersoll milling machine was employed for machining the sides of the segments which were stacked two-high for the purpose. It was driven by a 50-horsepower, direct-connected motor and was provided with two tables so that one could be loaded while the other was passing under the cutters. These machines, known as hoggers, milled both sides of the segments simultaneously and completed two segments every 15 minutes. The segments were held in a patented chuck designed especially for the job.

The tapered ends were machined on planers also provided with two tables and two cutting heads. A row of castings was loaded and clamped on one table while the row on the other table was being machined. The key segments were machined on an Ingersoll milling machine which was equipped for milling the ends and the sides. The table had a capacity of five segments while milling the sides and five while milling the ends. Each machine was served by a 3-ton traveling crane. Before the castings were shipped they were examined by a representative of the public service commission, who employed templets to test the accuracy of the joints and the spacing of the bolt holes. Prior to shipping, the castings were tarred and the machined surfaces coated with grease to prevent rusting. The analysis of the castings conformed approximately to that of No. 2 foundry pig iron. Silicon 2.50 per cent; sulphur 0.05 per cent; phosphorus 1.00 per cent; manganese 0.70 per cent.

FIG. 6—THE COPE IS RAMMED ON A PLAIN JOLT MACHINE, LIFTED OFF AND PLACED DIRECTLY ON THE DRAG

New British Ventures

Light Castings Ltd., Manchester, England, is the name of a new company which has recently been organized to represent the interests of a group of prominent British foundries in the building hardware and other light casting fields. The companies which are interested in the new organization include M. Cockburn & Co., Ltd., Falkirk, Scotland; McDowall, Stevens & Co., Ltd., Falkirk, Scotland; the Planet Foundry Co. Ltd., Sheffield; and the Coalbrookdale Co. The new organization will engage in the manufacture of builders hardware and light castings of various descriptions.

Another interesting new foundry development in the United Kingdom, with which prominent members of the National Light Castings association also are connected, is the United Foundry Co., which is now building a plant at Malton, Yorkshire. It is expected this shop will eventually have a capacity of 150 tons a day. At present one 72-inch cupola built by the Constructional Engineering Co., Ltd., Birmingham, England, is being installed. J. Campbell of Gadsden, Ala., is superintending engineer of the United Foundry Co.

Will Construct Furnaces

The Industrial Furnace Builders, Inc., 53 West Jackson boulevard, Chicago, has been formed to construct furnaces other than electric heat source units. It now has in hand the construction of a twin chamber malleable melting furnace equipped with powdered coal burning devices for the Niagara Radiator & Boiler Co., Eighty-third street and Woodlawn avenue, Chicago. Each chamber of this furnace has a capacity of 10 tons.

The electric tramrail division of the Cleveland Crane & Engineering Co., Cleveland, has appointed L. E. Salom, as district representative for its New York territory. Mr. Salom will make his headquarters at 50 Church street, New York.

How and Why in Brass Founding

By Charles Vickers

Pinholes in Brass Due to High Sulphur

We have experienced considerable trouble from pinholes in our brass castings. The rough castings appear perfectly satisfactory, but after machining the holes appear. We are melting in coke-fired tilting furnaces, using No. 150 *pots and the following mixture: Copper,* 176 *pounds; tin,* 6 *pounds; lead,* 6 *pounds; zinc,* 12 *pounds; turnings,* 50 *pounds; sprues and gates,* 150 *pounds. The metal is poured at about* 2200 *degrees Fahr. The pinholes are fine, and we assumed the metal was absorbing an undue amount of sulphur from the coke. We procured a better grade with the result that the trouble completely disappeared for about three weeks, only to return suddenly when to all appearances the same kind of coke was being used. An analysis of the brass castings showing pinholes revealed the presence of* 0.14 *per cent sulphur, while castings free from these defects analyzed* 0.10 *per cent sulphur content. We would like to have your views as to the cause of the pinholes.*

Probably the coke is not entirely to blame for the high sulphur content of the metal, for if the metal is covered with charcoal, the sulphur atmosphere of the furnace can affect the metal only before it melts, and at this stage considerable protection would be afforded by the use of a little salt, or preferably a little manganese chloride. The high sulphur content of the metal may have been built up by several remelts through the medium of the chips. If a cutting compound, high in sulphur is used in machining the castings, this will carry sulphur into the metal. We suggest an investigation of the cutting compound, as some of them run high in sulphur. If the compound is at fault, burning off the oil will not help matters in the least. The only thing that can be done is to wash the chips in sodium hydroxide solution, and that is an unpleasant proceeding. Metal containing from 0.10 to 0.14 per cent sulphur is useless for any kind of pressure work, and in the case of other castings, if the metal is oxidized a little in melting, pinholes will result due to the reaction between the oxygen and the sulphur. The pinholed castings should be segregated and proportioned with new metal sufficient to cut down the sulphur to the point where the holes will disappear. The highly sulphurized metal now on hand should be used, and a start be made with low sulphur metal. This can be done by the co-operation of the chemical laboratory.

Melting Nickel in Alloys

We would like to know how best to melt nickel. Is there a special flux that will make it melt more rapidly? So far we have not used any flux whatever. Our formula is composed of copper, aluminum and nickel, and the way we are working, our copper burns before the nickel melts.

A convenient way of using nickel is in the form of an alloy of 50 per cent copper and 50 per cent nickel, an alloy that can be bought from a number of concerns who specialize in the making of such alloys.

This alloy melts much more easily than nickel alone on account of its copper percentage, and in using it in alloying the copper is compensated by decreasing the amount of unalloyed copper added. In melting nickel, a flux of lime and fluor spar is used, the proportions being roughly three parts of lime to one of fluor spar, the latter being increased if the flux fails to melt to a fluid covering. However this flux will not make the nickel melt faster, the only thing that will melt the nickel is heat and it will require greater heat as the content of nickel is increased.

Remelting Nickel Anodes

We are wondering if there is any way in which we can melt and recast our scrap nickel anodes. We have been in the habit of selling this material and buying new ones, but if we can re-cast the scrap it would mean a material saving.

No difficulty should be experienced in melting this scrap and recasting it into new anodes. An oil-fired brass melting furnace taking a No. 40 crucible would make a suitable melting medium. It is necessary to have a furnace that can be quickly raised to a high temperature, and for this reason a solid-fuel furnace is not satisfactory. The molds are made in two-part flasks in the usual way, but it is advisable to use a facing of silica sand bonded with good clay and molasses water to about the consistency of molding sand. Use a steel molding facing such as silica flour for painting the molds before drying.

If part new metal is used with the scrap, more castings will be obtained. The mixture for new anodes follows:

NICKEL ANODE MIXTURE

	Pounds
Nickel	92
Old files	4
Tin	4

Use a flux of fluorspar and lime. First, melt the nickel and the files together and ingot them. Remelt the ingots with charcoal as a cover and add the tin. Use half the above mixture and half scrap anodes. The result should be as good as the new anodes.

Hard Bronze Alloys

We are in need of a special bronze alloy giving a special strength, toughness and endurance while under wear. The alloy is used in a paper mill machine where two pieces of metal rub together forming some kind of a knife to cut stock. We have tried several formulas with little success as the customer claims the castings are wearing faster than they should Our last formula was composed as follows: Copper 87*; tin* 10*; aluminum* 1½*; and nickel* 1½ *per cent.*

The following alloy should be sufficiently hard for the purpose, but if toughness as well as hardness is required it cannot be obtained in the same alloy. In such a case the hard alloy should be backed by a tough, ductile alloy which is riveted and also brazed onto the hard alloy.

HARD ALLOY

	Per cent
Copper	55
Nickel	33
Aluminum	12

The hardness number of the above alloy as cast is Brinell No. 302, using the 3000 kilogram weight. There are few harder bronzes than the above.

Probably a *stainless steel* would be more suitable in this case than a bronze or the customer expects too much of the bronze.

Electric Furnace Strengthens Iron

Work on the Production of Synthetic Pig Iron Is Reviewed and a Comparatively Inexpensive Type of Electric Furnace Is Outlined for the Gray-Iron Foundry

BY D. WILKINSON

AT THE present time attention is being directed toward the electric furnace as an iron foundry appliance. From the earliest days of electric furnace development pig iron has been reduced from the ore by various types of this furnace; but the use of the electric furnace, either to replace the cupola or as an adjunct to it, only recently has been seriously considered. Much water will flow under the bridge before the cupola is displaced in the foundry, but it is conceivable that for certain purposes the increased cost of electrically treated cast iron might be compensated for by its improved quality.

It is easily possible to obtain as poor an iron from an electric furnace as is ever produced by the cupola. However, when the iron is properly handled, the resulting improvement is so marked that for certain classes of work the increased cost should not be prohibitive. But for general castings the increased selling price would entirely prevent sales, and no good purpose can be served by improving a material in a manner that puts it out of the market.

The replacement of the cupola by the electric furnace may be considered along the lines of what is now known as the manufacture of synthetic cast iron.

In 1915, when the shortage of low-phosphorus iron was very acute, the writer, in his search for supplies of this material, visited a small works where synthetic cast iron was being made in an ordinary electric furnace. Various grades, from white to all gray were being produced. All the fractured surfaces were finely grained and the tensile strength of the gray iron was said to be 45,000 pounds per square inch. The venture, despite the abnormal demand for low-phosphorus iron was not a financial success; doubtless owing to the small size and unsuitable design of the furnace.

The production of synthetic cast iron was developed on a large scale in France during the war for the manufacture of cast-iron shells. A description of the process was given in a paper read before the British Iron and Steel institute in 1919, by C. A. Keller, and published in the June 15 issue of THE FOUNDRY, the same year.

The process is simple in principle. Steel turnings, mixed with carbon in the shape of small pieces of coke or charcoal and a proportion of the lime and sand, are charged into an electric furnace. As the charge heats up the carbon combines with the steel reducing its melting point considerably. The lime and sand serve a double purpose. They reduce the high conductivity of the slag and so enable the use of an ordinary voltage in the furnace. The lime, under the strongly reducing conditions resulting from the amount of carbon present, combines with the sulphur in the steel and carries it into the slag. The silica of the sand is reduced to silicon by reaction with iron and carbon, and results in the production of gray cast iron. The process can be closely controlled and yields a really excellent cast iron. As much as 300 tons per day of this material is said to have been made by this method at Livet, France, where there is a large installation for the generation of electricity by water power. The current consumption is stated to have been as low at 675 kilowatt hours per ton. The following composition is given:

	Per cent
Carbon	2.90
Silicon	1.75
Manganese	0.50
Sulphur	Traces
Phosphorus	0.05

From this iron a tensile strength test of 71,000 pounds per square inch is said to have been obtained. While the writer has obtained some excellent tensile results with electrically treated cast iron, this figure goes far beyond the best he has ever seen.

Synthetic cast iron can be made in any ordinary electric steel furnace, and during the period of the war the writer assisted in carrying out some trial runs which so far as product was concerned were satisfactory. If only the cost had been as satisfactory as the product something might have been developed from the experiments. In these trial runs the turnings and the coke used were of the following composition:

Turnings	Per cent
Carbon	0.42
Silicon	0.21
Manganese	0.79
Sulphur	0.068
Phosphorus	0.058

Coke	Per cent
Carbon	88.40
Volatile matter	1.36
Sulphur	0.93
Ash	9.21

It is necessary to use turnings and to thoroughly mix the ground coke with them in order to economize current. Ordinary foundry or forge scrap does not expose sufficient surface to the carburizing action of the coke mixed with it to complete carburization before melting. If the charge melts before carburization is complete, the remaining carbon must be absorbed by the molten metal, and the solution becomes slower and more difficult the higher the percentage of carbon rises. To introduce about 3 per cent of carbon into the resulting cast iron, 5 per cent of ground coke is necessary; also 5 per cent of lime and a little sand is added to form a desulphurizing slag. This mixture is charged on the preheated hearth of an electric furnace and the circuit is closed.

Carburization begins at a dull red heat and becomes more rapid as the temperature rises. As the charge becomes semimolten the action is energetic, and by the time fusion is complete, in the neighborhood of 3 per cent of carbon will usually have been absorbed by the metal. By the action of the lime, the sulphur will be considerably reduced and the resulting metal will be a good quality white iron. In operation it was found more economical to add the silicon by means of ferrosilicon rather than by the reduction of silica in the furnace. The time taken to reduce the necessary amount of silicon would increase the current consumption considerably; and it costs less to use ferrosilicon than to use the current required by the reduction. When, after adding the ferrosilicon and rabbling, a test sample showed a gray homogeneous fracture, the metal was poured out and cast.

As regards the composition of the product, the sulphur was reduced considerably; the phosphorus was not

Paper presented at a meeting of the Birmingham branch of the Institution of British Foundrymen. The author is foundry manager of the Austin Motor Works, Longbridge, Birmingham.

altered and the manganese lost usually about 10 per cent of its amount. To make up this loss a few pounds of 80 per cent ferromanganese was added to the ladle. The analysis of one heat was:

	Per cent
Combined carbon	0.47
Graphitic carbon	2.16
Silicon	2.28
Manganese	0.84
Sulphur	0.022
Phosphorus	0.060

Material of this composition showed a tensile strength of from 44,600 to 48,100 pounds per square inch. Transverse tests taken on a bar 1 x 2 inches, with 3-foot centers stood a load of 4400 pounds with 7/16-inch deflection. The specific gravity was 7.53. As the average specific gravity of gray iron is about 7.2, the higher specifiic gravity of synthetic cast iron shows it to be of a considerably increased density. The conditions under which it is made ensure its perfect deoxidation, and its freedom from othed dissolved, occluded or combined gases will be rendered certain by the temperature to which it is raised, and by the strongly reducing slag covering it while in the furnace. Microsections showed the graphite in an extremely fine state of division and uniformly distributed in a matrix of pearlite and silicoferrite.

The metal was intensely hot and fluid. Molds cast with it had to be prepared with great care if smooth castings were to be obtained. When poured into the molds it remained fluid for a considerably longer period than cupola metal; and its feeding qualities were obvious when the sinking down of the runners and risers was observed. The castings were close grained and sound; and the high specific gravity resulting from the close grain marks it as being suitable for light castings to resist internal pressure. Its fluidity was such that the runners were reduced in number and in size without the slightest tendency toward cold shuts or misruns. Dry sand molds had to be closed with great care and cottered tightly to prevent runouts; and if a runout did occur it was difficult to stop it.

Cut Power Consumption

The use of the cupola in conjunction with the electric furnace will effect a considerable saving in power consumption; and the quality of the resulting metal can be made equal to that of synthetic cast iron. If the electric furnace is to be developed in the cast iron industry it will be essential to obtain the utmost economy. The purchase and maintenance of an electric furnace and the high price of electric current add to the cost of gray iron castings made by this process. Melting in the cupola is certainly cheaper than melting in the electric furnace and in the interests of economy this should be done. As regards the composition of the metal thus treated, when compared with synthetic cast iron, the amount of phosphorus could be kept low by the use of low-phosphorus pig iron; but in the writer's opinion a moderate amount of phosphorus would not be objectionable. In fact, phosphorus up to 0.3 or 0.4 per cent would be an improvement, as it would increase the rigidity of the metal and yet not be sufficient to induce brittleness. The percentage could readily be obtained by the use of a medium-phosphorus pig and steel scrap.

A basic lining in an electric furnace is not at all suitable for iron foundry requirements. The furnace itself could be so modified that it would be much cheaper to erect and maintain, and more convenient for use with cast iron than any so far introduced. Few foundries require molten iron for more than three or four hours daily. The foundries requiring molten iron continuously, that is, for 20 to 24 hours per day, are so few that they do not enter into the general question. This intermittent demand for metal is a source of serious trouble and expense with a basic-lined furnace. Unless a basic lining is kept constantly hot, it rapidly disintegrates and is destroyed. At the temperature required for cast iron a basic hearth in continual use would last at least several months; but if it were allowed to cool off each night it would not last many days owing to the severe stresses, set up by alternate expansion and contraction, cracking the lining and making it spall off when heated again.

The writer would suggest, instead of a basic hearth, a neutral one made of carbon. This would not be possible in steel melting, as the steel would attack and destroy it; but cast iron already heavily charged with carbon, would have no action on it.

The calcareous slag required would also, if properly proportioned, be without chemical action upon it. The furnace itself should be built after the manner of an air furnace; well braced with buckstaves and side plates. An electric furnace handling cast iron need not be tilted. A furnace solidly built, with walls and roof of the highest quality firebrick, having a hearth about 5 feet by 2 feet 6 inches, with well tapered sides about 1 foot 8 inches deep would hold 3 tons of cast iron and the slag required to refine it. The electrode holders either could be attached to the walls, or built up separately. At one end a tapping hole and spout should be located, and at the other end a charging spout should be fixed. This spout should be sloped gently upward from the top level of the hearth and should be closed where it enters the furnace by a small door. The roof preferably should be movable to facilitate repairs. A door on the side opposite the electrodes would allow the refining to be observed and would also enable the melter to handle the slag. The hearth should be made of ground coke mixed with hot pitch and tar in suitable proportions and solidly rammed into place. Two electrodes only would be required, with Scott connections to three-phase current at the transformers. Such a furnace would, with care last at least as long as an air furnace and would be considerably cheaper to build than an ordinary electric furnace. Also it would not be injuriously affected by being frequently heated and cooled. A furnace on these lines could easily handle 20 tons of cast iron during an afternoon.

Refine Cupola Metal

If such a furnace were used in an iron foundry, about 2 hours before the blast is put on in the cupola the furnace, cleaned and patched after the previous day's run, would be charged with about 1 ton of small scrap from the last heat. A liberal amount of ground coke would be spread over the iron. Current would be turned on slowly at low power to begin with, and gradually increased as the furnace warms up. After from 1½ to 1¾ hours, the scrap would be melted and covered with the ground coke, and the furnace would be fairly hot. The lime sand and fluor spar to form the slag would then be charged, and by the time the cupola was delivering metal the slag would be melted, the furnace would be hot and the iron already in it would be in good condition. From the cupola 2 tons of metal would be tapped and poured down the charging spout into the furnace, mixing with the iron and slag already there. The full power, from 700 to 800 kilowatts would be switched on and refining would begin. The first heat would probably require about half an hour's run. Experience would soon show the correct time to start the furnace so that by the time the first heat was refined, the furnace would be at the full temperature. Two tons would be tapped out and another two tons brought from the cupola and poured into the remainder of the charge left in the now highly heated furnace. Deoxidation and desulphurization would be rapid

under the action of the hot active slag. At intervals as the slag became spent it would be partially raked off and new slag-forming materials added. By adding carbon, fluor spar and lime as required, a strongly reducing slag could readily be maintained. By working in this manner, taking out only two tons per tap, leaving the remaining ton to mix with the fresh cupola metal, it would be possible to make a tapping every fifteen minutes, taking off two tons of thoroughly deoxidized, desulphurized and superheated metal. The metal as drawn off would be at such a temperature that, if covered with blacking, it would be kept until the next tap was made and still be hot enough to satisfy the most exacting demand for hot iron. With good cupola practice and treatment under these conditions a good grade of metal with high physical properties could be relied on with certainty.

New Open-Hearth Port Speeds Melting

BY HERBERT F MILLER JR.

CONSIDERABLE difficulty is experienced in keeping both dry and water ports of open-hearth furnaces in the shape of their original lines. With dry ports the bricks melt and drop out of the port arches, plugging the port and deflecting the gas on the roof which is burned. Water ports in general overcome these troubles in a degree. The important defect in water ports is that a deposit forms inside the port and rapidly builds up. This deposit is difficult to remove and often requires hours of labor.

To overcome these difficulties and also to have a port which will give more efficient and quicker melting conditions, George F. Downs and Herbert F. Miller Jr., Lackawanna Steel Co., Buffalo, have designed and patented two types of ports. The three views in the accompanying illustration show the general details of the construction of these ports.

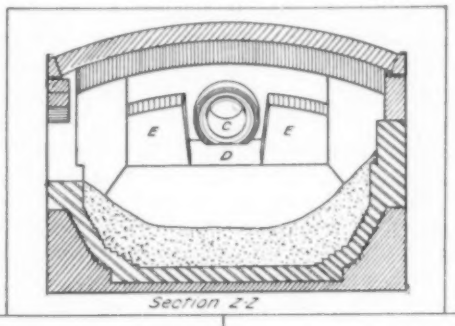
One of the two types of ports is designed to be suspended independently of the brickwork by means of water cooled pipes. The other type is built in the brickwork and thus gets its support. Other than these differing means of support, the ports are identical. The original ports with over two years successful service behind them look good for many more years. The port is a hollow, water-cooled flue, tubular in shape. It is less than 40 per cent of the weight and surface of other water cooled ports.

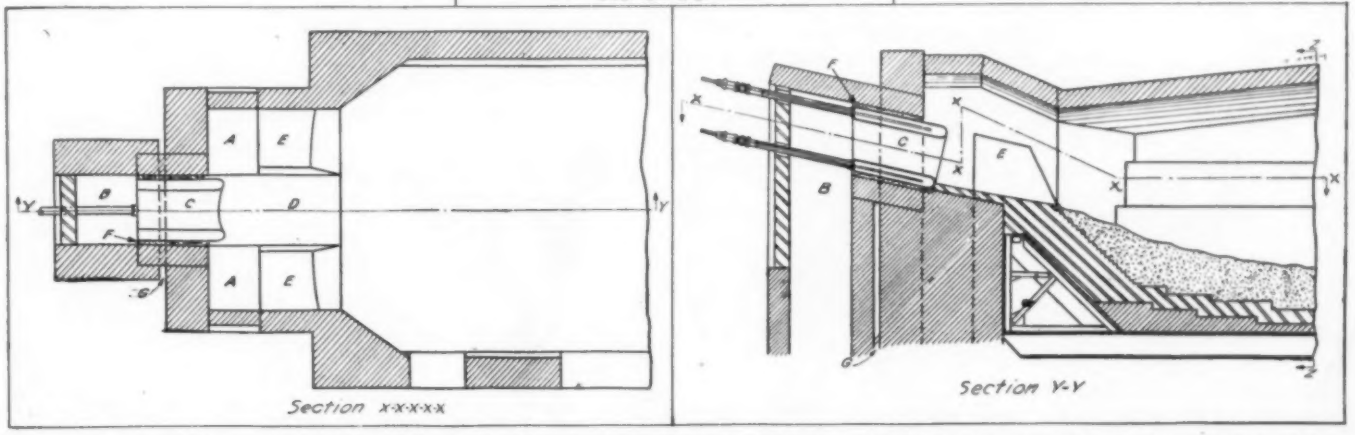
The port extends from the gas uptake into the air port, but not entirely across the air uptakes. This permits the rising current of pre-heated air to forcibly mix with the stream of gas as it issues from the port. By this action the combustion starts immediately and rapidly so that by the time the gas reaches the bath, the flame is in shape to melt the scrap.

The design of port used acts to keep the tail end of the flame low on the outgoing end and to keep the flame away from the side walls by forming the draft in fairly straight central lines in the hearth. The flame comes into the hearth clear of the roof and at the second door coming in the flame is not much higher than the wicket hole and it goes out of the hearth at the same level.

The gas port itself being of small dimensions and the exposed surface a minimum makes its cooling effe on the incoming gas and outgoing waste gases negligible. This is proved by the fact that the incoming flame is hotter on this type of port than that from a dry port. One installation in a furnace charging 160,000 pounds of metal with a 14 per cent limestone burden has ports only 29 inches long and is making its heats in less than 10 hours, many of them going out under 8 and 9 hours. Installations in larger furnaces are giving a larger tonnage per hour.

The author, Herbert F. Miller Jr., is open-hearth efficiency engineer, Lackawanna Steel Co., Buffalo.





THREE VIEWS OF A NEW WATER COOLED OPEN-HEARTH PORT DESIGNED TO PROLONG THE LIFE OF THE PORT AND TO THROW THE FLAME NEAR THE CHARGE INSTEAD OF AGAINST THE ROOF OF THE FURNACE

Nomenclature: A-A, Air uptakes—B, Gas uptake—C, Port cooler—D, Combustion chamber—E-E, Blocks—F-F, Ground silica-brick packing—G-G, Air space between gas and air uptakes

Massachusetts Foundry Is Completed

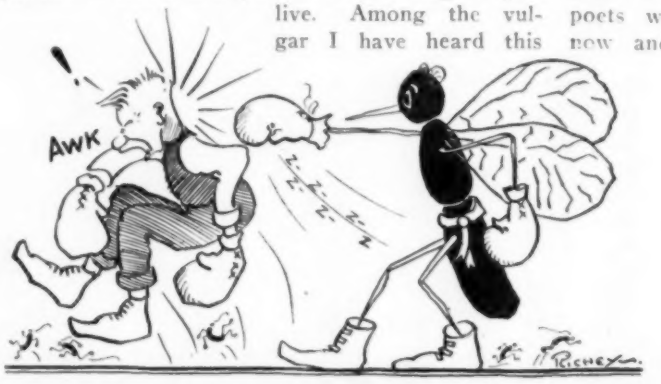
The foundry of the Southbridge Foundry Co., Southbridge, Mass., which was erected by the Truscon Steel Co., Youngstown, O., has been completed and the company began business Jan. 30. The main building is of steel and reinforced concrete, one story high, 50 x 100, with an ell 20 x 30 feet of the same material. Frank S. Mills, formerly of Palmer, Mass., is president and general manager, and Arthur A. Allard, treasurer of the company, which will make iron castings of all kinds.

Bill On Pattern Mounting Methods—II

BY PAT DWYER

EVERY once in a while you see a statement to the effect that a taste for good literature may be acquired if one only persists long enough. Those who make this claim back up their contention by pointing to the ease with which a man may cultivate a taste for certain articles of food, which on their first appearance offend possibly three of his five senses; sight taste and smell. I wouldn't go so far as to say that the people addicted to making statements of that character are talking through their collective hats, but I will say that I think their confidence is beautiful and touching. Faith always is beautiful; but as a certain illustrious writer set down in one of his famous epistles, "Faith without good works is dead." Really to understand and appreciate fine literature involves an intensive course of hard study and concentration and that is something that appeals to a comparatively small number. On the other hand, some forms of common, or ordinary literature, appeal instinctively to a man and are absorbed without difficulty. For instance, consider poetry and contrast the difficulty you would experience in memorizing a few stanzas from Byrant's Thanatopsis, with the ease and facility with which you picked up the words of the stirring ballad describing Mary Ann McCarthy's exploits while engaged on a memorable clam digging expedition. This beautiful and sprightly little pastoral ode, author unknown, probably has done more to brighten up many a convivial gathering than any other single factor even including that equally well known classic eulogizing the virtues of the jolly good fellow whom nobody will deny. In fact there is a certain similarity in the construction of the two masterpieces which might lead one to infer that possibly they were composed by the same inspired writer. Simple and chaste in diction, a repetition of the lines lends emphasis without detracting from the dignity of the opening statement, while the concluding line, leading up in a crescendo movement to a convincing and dramatic climax leaves nothing to the imagination. Set to the martial music of John Brown's body which lies a-moldering in the grave, those with a limited or even with no musical education, experience no difficulty in marking time to the stirring measures, with special emphasis on the second last bar. In the event that an orchestra accompanies the singers, there is an unwritten rule among the musicians that the bass drum takes the two beats in the second last bar as a solo, *forte*, while every voice and instrument joins in one prolonged howl of joy and exultation on the last bar of the measure.

Frequently, as the readers of these memoirs probably have noticed, I have presented problems of various kinds before Bill for his consideration. I have not accepted his conclusions invariably, and on occasion I have questioned the authenticity of some of his statements, but trifles of that character do not affect Bill's equanimity. He holds decided views on subjects with which he is familiar and is ready to express an opinion on practically any subject to be found in the usual 24-volume family encyclopedia, $1 down and $1 a week as long as you live. Among the vulgar I have heard this arrangement referred to as "$1 down and the remainder when they can catch you," but I think that may be regarded as a crude form of pleasantry and is not to be considered seriously.



POISON PETE BOWS TO MANDATE OF PEACE CONFERENCE AND ADOPTS HUMANE METHOD TO KNOCK 'EM OUT

A friend of mine living in New Jersey recently sent me a poem clipped from a magazine, with a verse of his own composition tacked to the end. From various more or less reliable sources I have gathered the impression that a citizen of the sovereign state of New Jersey practically could get away with almost anything short of mayhem on account of the vagaries incident to even a slight attack of mosquitobus. However, unless the mosquitoes have taken to wearing wool mittens and goloshes, a remote contingency, I don't see how the usual alibi can be invoked in this case. The last time I was over to Bill's place I showed him the composition and asked him what he thought of it. I had rolled the thing into a thin spiral the way some people roll a street car transfer, either through absent mindedness, as in my case, or through a sheer spirit of perversity which prompts some to bother the other fellow as much as possible. At first Bill refused to accept it. He said that he didn't mind rolling his own, but as long as he had his health and strength he did not propose to be any person's goat. If I wanted the thing unrolled I had better do it myself. I told him that all our best poets were rolling their manuscripts now and tying them with bows of baby blue ribbon and that it was only in deference to his grimy foundry paws that I had removed the ribbon before I had left home. "I don't know about the ribbon," said Bill, "but I know that in all the advertisements I have read about rolling your own, the word bull figures prominently and I should not be surprised to find that the dope in this

pipe lighter came from the same or a similar factory. However, I have been taking chances all my life and I guess one more stab in the dark won't do one any harm." He spread the paper on a drawing board on which he had been working and having fastened the four corners down with thumb tacks read the following effusion from our poetical New Jersey friend:

Tobacco is a filthy weed,
I like it,
It satisfies no normal need,
I like it.
It makes you thin, it makes you lean,
It takes the hair right off your bean,
Its the darndest stuff I've ever seen,
I like it.

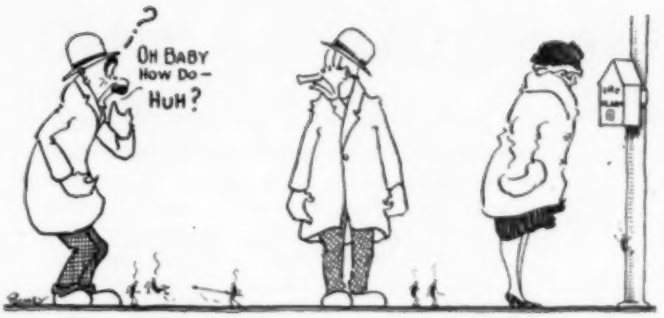
* * *

The chicken is a tender bird,
I like it,
Its plumage scanty and absurd,
I like it.
It's skirt is risque, short and sweet,
Its waist is openly indiscreet,
I blush to meet it on the street,
I like it.

* * *

The foundry is a dirty place,
I like it,
It spoils your clothes, it smears your face,
I like it.
It's full of smoke, it's full of smell,
It chokes you with dust so you cannot yell,
It's a fair imitation of a little hell,
I like it.

"I never claimed to be a prophet nor the son of a prophet," said Bill, "but I think you will have to admit that I struck twelve in my diagnosis of your precious poem even before I had read it. All the bird who wrote it wants is a wide sombrero, a little embroidered jacket, a pair of satin knee breeches and a steerage ticket to Seville or Madrid. The first verse is a base libel on a plant that has afforded solace, peace and comfort to millions of men and boys to say nothing of the dear old grannies who sit in the chimney corner puffing contentedly on their little black clay pipes. Takes the hair right off your bean, Eh? How do you account for those venerable old gents with heads like billiard balls to whom the word tobacco is anathema and who never even polluted their virgin lips with a cubeb cigaret? I shall not comment on the second verse because what's the use? They wear 'em to suit themselves. I don't pretend to know as much about the subject, for instance, as Solomon the hero of a thousand fights, but I do know that the author of the lines 'When a woman wills, she will and that's the beginning o' it; and when she won't she won't, and that's the ending o' it,' said a mouthful. In this connection, also, you probably have noticed an exemplification of one of the inexorable laws of nature whereby a balance constantly is maintained. As the skirts steadily grew shorter, the bills steadily grew longer and there y'are. Incidentally it might be added that the shorter the dress, the longer the looks,, and outside the formality of complying with the civil code which prescribes that a covering of some kind must be worn on the body in public, I think I am quite safe in assuming that a dress which does not attract attention is regarded as a dismal failure.

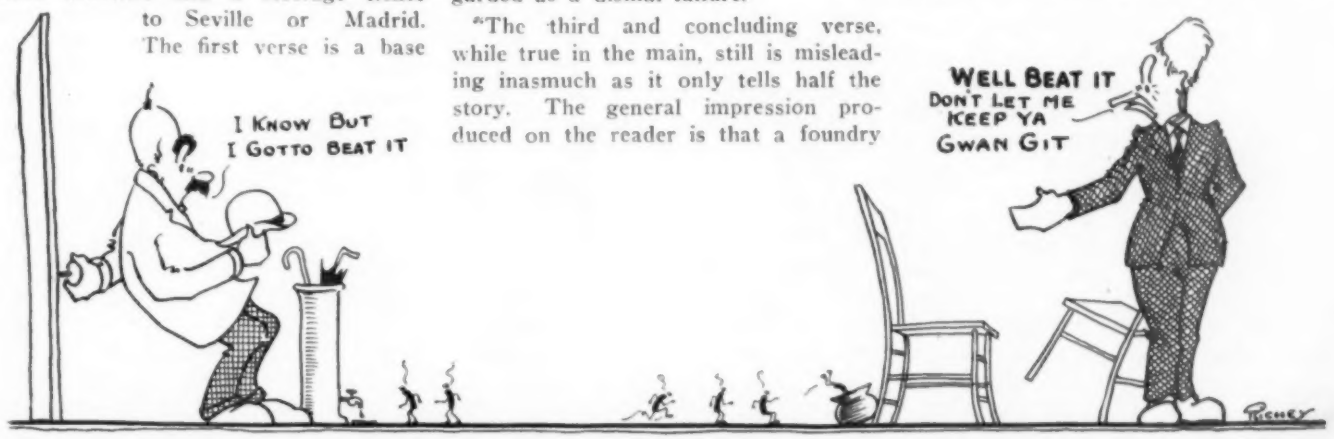


SHORT SKIRTS COVER A MULTITUDE OF SHINS

"The third and concluding verse, while true in the main, still is misleading inasmuch as it only tells half the story. The general impression produced on the reader is that a foundry is a first class place to keep away from and that any man willing to go back to such a place day after day must be a victim of that peculiar and distressing malady known among the elect as bats in the belfry. It may be a dirty place, although dirt after all is only a relative term, and it certainly is no place for a man who thinks that the Lord hung a pair of lily white hands on the ends of his arms purely for ornamental purposes. There is no use in trying to disguise the fact that the smell pervading a foundry about 3 o'clock in the afternoon differs radically from the aroma which assails the nostrils of one attending a pink tea in some exquisite's apartments about the same time o'day, but that is a long way from saying 'that the foundry suffers by comparison. Balancing a tea cup and a lemon wafer on one knee may represent the result of years of training but I am doubtful if the effort contributes as much to the progress of the world's work as the ability to balance a ladle so that it may be tipped with a minimum of effort and under such perfect control that the molder can *cut her short* the instant the metal appears in the riser."

I admitted to Bill that I had not given the subject any serious consideration. The poem struck me as being a clever little composition, catchy, you know, and neatly put together. As for analyzing it, seeking for hidden meanings and all that kind of thing I am thankful to say I have done nothing of the kind since I left school and between you and me and the cupola I never intend to if I can help myself.

"Do you know," said Bill, "You make me think of the attitude maintained by many foundrymen. They hate to exercise their minds or try to improve existing conditions. For-



FROM THE WINDY ONES WHO TALK BUT NEVER KNOW WHEN TO STOP, GOOD LORD DELIVER US

tunately there are a sufficient number of the other kind to justify me in the belief that they are the salt of the earth and taking them as a class they exhibit as much ingenuity in developing and adapting labor saving devices as any other trade or craft in the industrial field. Was it not our mutual friend Henry W. who said something about the mills of the gods grinding slowly? I suppose there always will be pioneers, and there always will be those who are indifferent or slow about making up their minds to join the band wagon.

"For instance, consider the many methods that have been perfected for mounting patterns to facilitate production. One or more of these methods are in daily use in hundreds of foundries. They have been described at various times in the technical press, they have been made the subject of papers at foundrymen's conventions and yet it is astonishing to find the number of foundrymen who have no idea or at best a limited and hazy idea of how this work is done. Even in foundries where all or nearly all the patterns are mounted on plates of one kind or another it is not uncommon to find that the only man familiar with the method is the man in direct charge of that part of the work. Every one else from the superintendent down assumes the attitude that it is none of his business and why should he worry.

"An impression seems to prevail among jobbing foundrymen that unless an order calls for hundreds of duplicate castings it will not pay, and therefore is not worth while rigging patterns in a special manner. While it is true that shops running on long orders of duplicate castings afford the best opportunity for introducing economical methods of production, still the methods can be applied, sometimes in a modified form, in practically any kind of a foundry."

"You may be right in a general way," I said, "but what about those foundrymen, especially young men, who perhaps never have seen anything of that description? They may be keen enough, willing enough, but if they never have had an opportunity to judge the merits of pattern mounting methods, it hardly is fair to class them among the slow and indifferent. Then again, many men are familiar with plaster or composition matchplates, but have no idea how metal plates are prepared and outside of the pattern fitters who prepare the plates, it is doubtful if one foundryman in a hundred knows how to prepare a plate of small patterns so that both cope and drag halves of the mold can be rammed on the same plate."

"To tell you the truth, Bill," I said, "I am a trifle weak on that last point myself. I know that the cope is turned end for end before it is closed, but I am not quite clear in my mind regarding the manner in which the patterns are arranged on the plate so that the two halves will match when the mold is closed."

"Well," said Bill, "I'll tell you. Mounting patterns for work of that character is a tricky job, although comparatively simple when you know how. I should not be surprised to learn that you are hazy on many other phases of the subject, but like a true foundryman you won't admit it. Some time ago I started to prepare an article on the subject of pattern mounting with the idea in mind of describing practically every method. However, I found that to do the subject justice would make it too long so I have divided it into sections. I should like to try it on the dog before I submit it for publication, so if you kindly will stay as you were for a few minutes I shall read the first section."

"To kinda prepare your mind," he continued, "so that it will be in a proper receptive condition to receive the good seed I may say that the first section deals with more or less temporary methods of mounting patterns for short jobs. The second section deals with methods of employing plaster and compounds. The third section will take up the manner of preparing reversible plates, that is plates on which both cope and drag are rammed on the same face. The fourth section will go a little further along the same line, illustrating how two sets of patterns may be mounted on one side of a plate. Now if you are all set, let's go."

"Bill," I said, "you are like the man who took such a long run before he jumped that when he came to the jumping off place he had no breath, or jump, left in him. I should like to hear your story, but I have no intention of sitting up all night to do so. I shall come again when the night is young and when I have no place else to go."

"Suit yourself," said Bill. "At least I have one consolation. I am not the first and I don't suppose I will be the last to sprinkle pearls where they are not appreciated. On your way. Hurry home and don't stay playing with them bad little boys down at the corner."

Lamp Standards Present a Rough Surface

Question: Recently we have noted that the skin on some of the ornamental lamp posts made in our foundry is comparatively rough with the sand apparently burnt on in places. Our facing sand is made up of old sand 12 parts; new sand, 4 parts; sharp river sand 1 part; sea coal 1½ parts. The molds are sprayed with wet blacking and dried with a kerosene torch. Each casting is poured through a single runner with metal that is not too hot. We shall appreciate any information you can give us on how to produce a smooth skin on the castings. We are forwarding samples of sand and blacking for your inspection.

Answer: From an examination of the materials submitted and the information conveyed in your inquiry we should say that your blacking is too light and fluffy and probably applied to the molds too thin. Your black sand and facing sand appear to be quite satisfactory. We should recommend a finer grade of sand if you were making the castings in green sand molds; but since you skin dry them the relative fineness of the sand does not make so much difference.

It is possible that the workmen are hurrying over the job and do not dry the molds properly. If that is the case the cause of your rough castings is apparent and the remedy is to have some person in authority examine each mold before the core is set. A kerosene torch will dry a mold properly only if applied in an intelligent manner. In the hands of a careless workman it becomes a dangerous device. Careless manipulation of the air and oil valves may result in an unburned spray of oil falling on the surface of the mold so that it becomes impossible to decide whether a mold is damp or simply oil soaked. Again, an intense flame directed at one point too long may give the impression that the mold is dry, when in reality, when the flame is withdrawn for a few minutes the dampness from the back creeps in to the face. See that the blacking is stirred up before it is applied and if that does not produce a smooth skin get a better grade of blacking.

Henning Bros. & Smith, Inc., Engert avenue at Eckford street, Brookyn, has been formed to supply nonferrous foundries with brass and composition ingot, scrap metals, babbit, solders, etc. Henry Henning Jr. and Gustav Henning together with M. H. Smith, president, Smith & McCrorken, compose the new firm.

British Motor Castings Methods—IV

Molding Procedure Dependent on Whether a Machine Is To Be Used or Not—Patterns Gated To Cause the Aluminum To Flow Quietly

BY BEN SHAW AND JAMES EDGAR

TIGHTNESS of the crankcase casting is of considerable importance, hence an alloy of aluminum is preferred, and it is the difficulties experienced in producing castings in aluminum which call for a high degree of skill and ingenuity in the preparation of suitable molds. The high contraction of this metal is the principal cause of trouble and, as it is hot short, the mold must be so formed that it will crush under comparatively light pressure from the contracting metal. It is the disregard of this important factor which causes the high percentage of wasters in connection with aluminum castings.

The high shrinkage of this metal makes it desirable to have a regular thickness in the casting. Abrupt changes in the metal thickness should be avoided wherever possible as the irregular sections not only tend to draw and cause spongy metal, but set up unequal strains during the time of cooling. Though a regular thickness of metal in any one casting is desirable it is rarely possible so to design the work. Therefore, it is the duty of the molder to endeavor to equalize the cooling of the casting and introduce suitable feeders from which the heavier sections can draw metal when they are cooling. To assist the heavier sections to cool more rapidly denseners have and are being used with considerable success, so much so that their use has developed into a necessity. These denseners are composed of some metal having a higher fusing point than

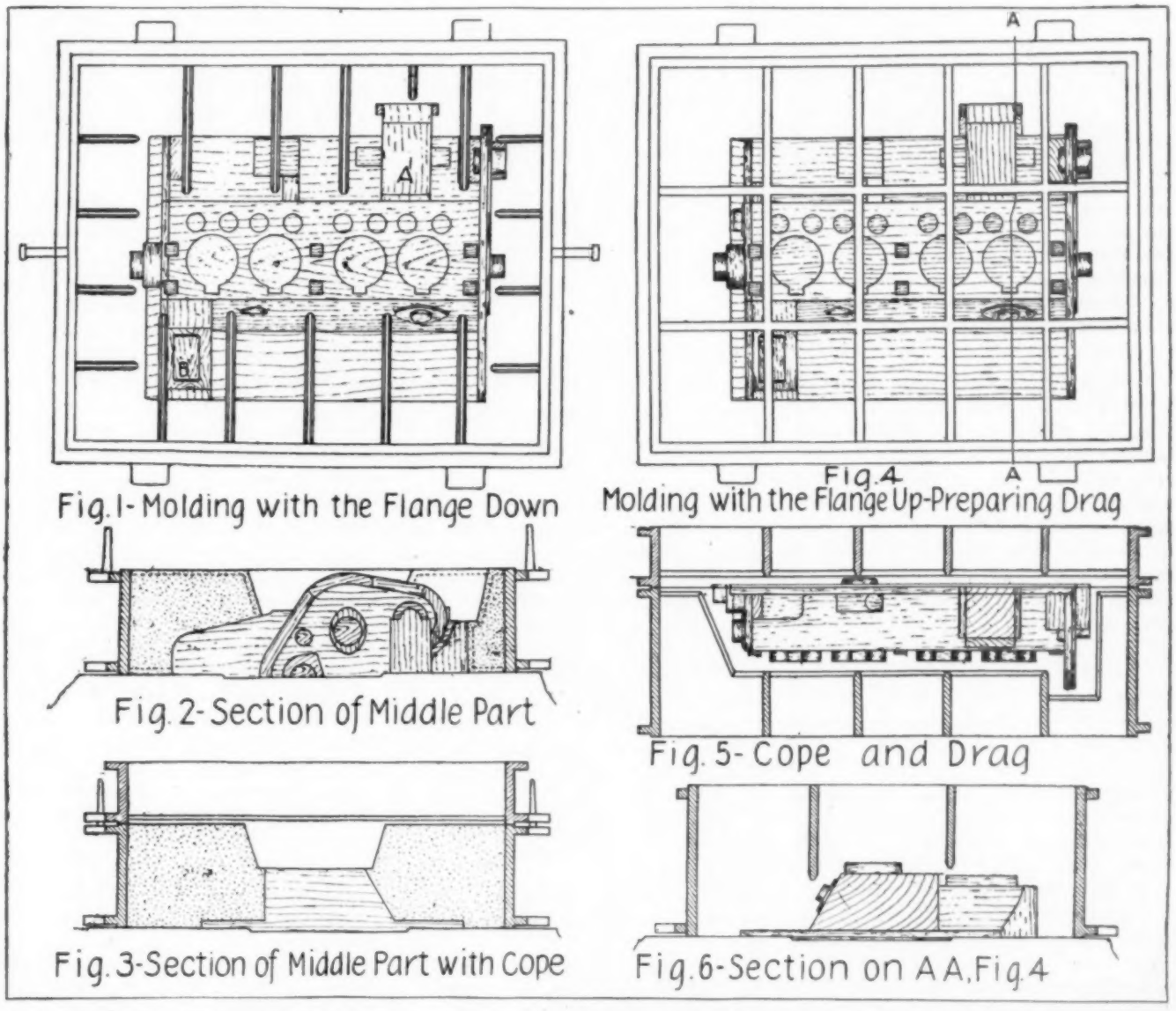

A
B
Fig. 1- Molding with the Flange Down
Fig. 2- Section of Middle Part
Fig. 3-Section of Middle Part with Cope
A
A
Fig. 4
Molding with the Flange Up-Preparing Drag
Fig. 5- Cope and Drag
Fig. 6-Section on A A, Fig. 4

FIG. 1—MOLDING WITH THE FLANGE DOWN FIG. 2—SECTION OF THE MIDDLE PART FIG. 3—SECTION OF THE MIDDLE PART WITH COPE FIG. 4—MOLDING WITH THE FLANGE UP—PREPARING THE DRAG FIG. 5—COPE AND DRAG FIG. 6—SECTION ON *AA*, FIG. 4

the metal to be used for the casting, and, as its main value is to reduce the temperature of the molten metal quickly, it should be a good conductor of heat. Pieces of copper are more frequently used for this purpose in connection with aluminum castings. They are made flat or circular according to the shape of the casting at the place where they are inserted into the mold. It is of course preferable to have these made before the mold is commenced so that they can be bedded into the sand during the time of ramming the mold. Considerable discretion should be exercised in the use of these denseners and where it is possible to feed a heavier section we believe it preferable.

Methods Varied by Requirements

The method of preparing molds for the type of crankcases illustrated in this article varies according to the number of castings required and the facilities available in the foundry doing the work. In some foundries, particularly those not fully equipped with modern molding machines, the practice is frequently adopted of casting the joint flange down with the idea of getting sound metal in that flange. The drag in such a mold merely carries an impression of the facings and the coreprints. In some cases only a two-part flask is used, but generally three parts are preferred. On the other hand, more modernized foundries prefer to cast the joint flange up. A two-part flask is then necessary. It may be an advantage to compare the two methods.

With the joint flange cast down the majority of the cores project above the drag and thicknesses are considered to be more easily checked. Should the cope carry all the rest of the mold then special guide pins must be used, but, whatever precaution may be taken, there is always a great risk of crushing in this method. To reduce this difficulty another part is employed and a tapered joint made down to the surface of the pattern. This reduces the possibility of crushing.

The method is costly and is not so convenient for adoption on a machine as it would be with the joint flange molded up. It has one important advantage and that concerns the running of the job. In pouring aluminum it is now recognized that it is important to avoid turbulence of the metal in the mold as it breaks the thin film of oxide which is formed on the surface part of which becomes imprisoned in the casting and more oxide is formed to cover the surface of the metal. It is because of this fact that aluminum castings are preferably cast from the bottom. Thus with the large flange of the crankcase cast down it is in a convenient position to have runners prepared on the joint. The method of preparing such a mold with a three-part box is indicated in Figs. 1, 2 and 3.

A bed is prepared on the foundry floor and the pattern is bedded in until the flange has a bearance, then a cheek is located over it as shown in Fig. 1. Sand is rammed about the pattern and a joint made as indicated in Fig. 3, but over the supports *A* and *B*, Fig. 1, it is better to prepare for drawbacks to carry the cores, so that they can be set separately, as shown in Fig. 2. A cope flask is then set and rammed up to take the top impression when the two parts are rolled over and the drag part rammed up last. Stripping is commenced from this position.

While this method is adopted in some foundries we do not suggest that it is

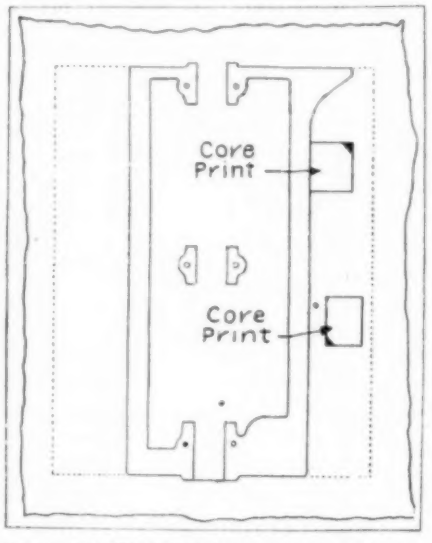


FIG. 7—FACINGS AND PRINTS LOCATED ON A PLATE FOR MACHINE MOLDING

the best and most economical. As a matter of fact castings of this type can be turned out rapidly on a machine and the method of casting the large flange uppermost increases the ease with which this can be accomplished. However, whether a machine is used or not, this method of casting possesses advantages over the previous method, which is recognized by its more general employment. In the first place the drag takes practically all the mold, and, with two minor exceptions, all cores are set in the drag and their surfaces are flush with the joint, each core being capable of being set into its relative position with little likelihood of becoming moved or crushed when locating the cope.

The square cored openings over the bolt hole bosses are then in the bottom, which leaves the top clear for using risers. Figs. 4, 5 and 6 show the type of flask used and the manner in which the mold is prepared. In this instance a solid flask is illustrated though frequently frames having bars secured separately to suit the work are employed. However, when many castings are required, it is better to prepare special flasks. When the molds are to be prepared on the foundry floor, journals should be cast in the ends of each flask section to facilitate the turning over after ramming. But if the molds are prepared on a machine with a rollover device journals are not so necessary. It is important to remember that the casting is to be in aluminum and the flask bars should be sufficiently clear to allow the sand to move while the casting is contracting.

It is necessary to prepare a bed, when using the floor, so that the pattern can be set in an inverted position upon it. A framed board will answer the purpose better and be more economical. In either case the flange of the pattern should come in contact with the bed to form the joint. Fig. 4 shows the pattern set on the prepared bed in an inverted position with the drag part located over it ready for ramming. Fig. 6 is a section through *AA*, showing the relation of the pattern with the bed on the floor.

Condition of Sand Important

Considerable attention must be given to tempering the sand for aluminum molds. The amount of water it contains should be just sufficient to make it cohesive. In this condition the sand becomes more quickly disintegrated after the metal is poured, therefore, it gives the casting greater freedom to contract, also. the sand is more porous when it contains less moisture and pressure against the casting is reduced. Moisture unevenly distributed in the sand causes a tendency to get damp places on the face of the mold and these cause sponginess in the casting. Aluminum being active in a molten state decomposes the water and absorbs some of the gases. The sand should be lightly rammed, just sufficiently to take the impression and enable it to withstand the rush of metal when casting. Those familiar with the density required for iron castings in green sand will realize that the sand need not be so dense for aluminum as less pressure is exerted.

When the flange is cast up it is more awkward to adopt bottom pouring. In some cases molders prefer to have the runners blocked in the pattern and a core made to carry the shape. When hand ramming is resorted to, a prepared runner is sometimes introduced during the time of ramming, a gate being set to coincide with it when commencing

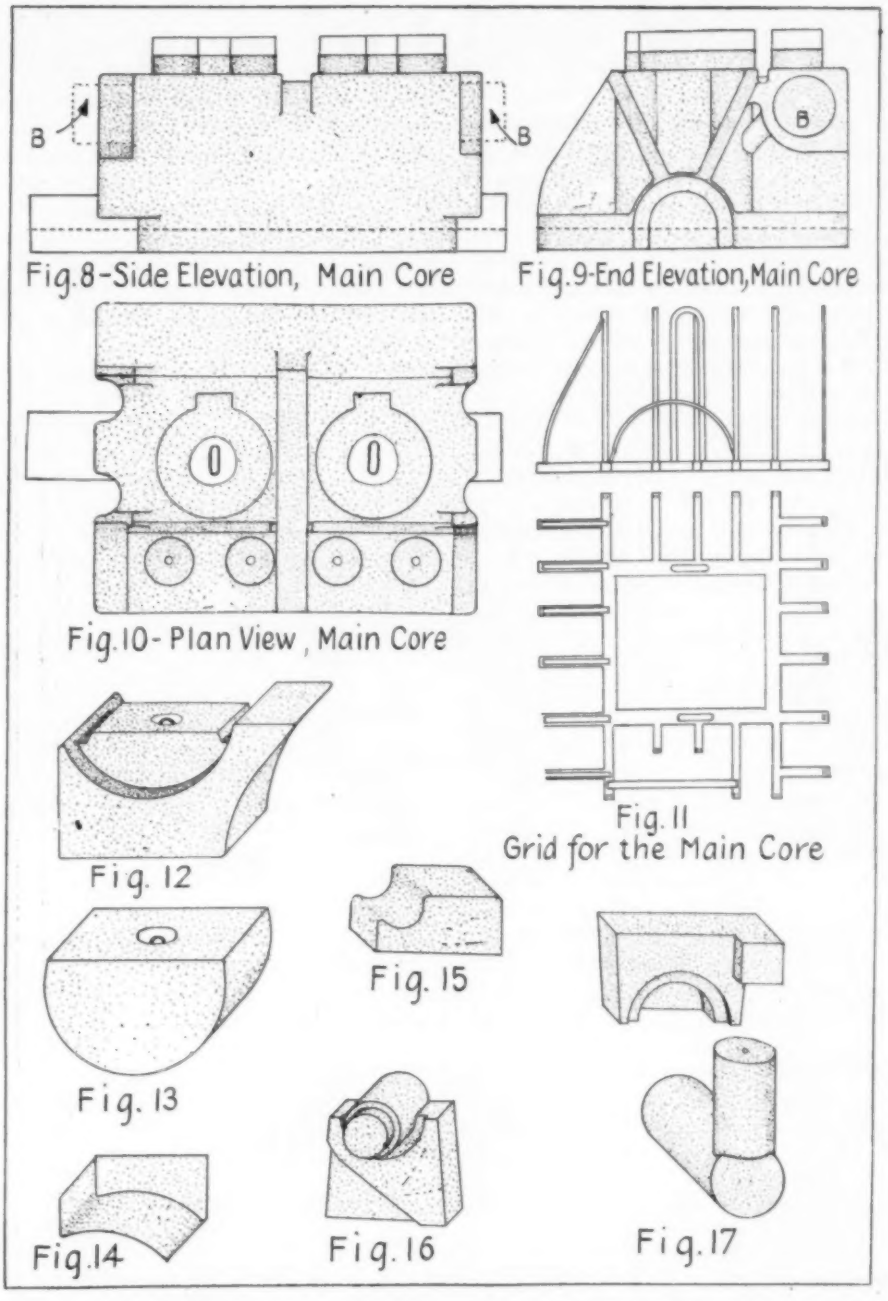


FIG. 8—SIDE ELEVATION, MAIN CORE FIG. 9—END ELEVATION, MAIN CORE
FIG. 10—PLAN VIEW, MAIN CORE FIG. 11—GRID FOR THE MAIN CORE
FIGS. 12 TO 17—MISCELLANEOUS SMALLER CORES

to ram the cope. Many obtain good results from a spray supplying metal to the side of the top flange, and this method is frequently adopted for machine molding because of its convenience.

The drag having been rammed is turned over and the cope part located, as shown in Fig. 5. It may be noted that when the flange is molded up the cope is almost flat, and therefore only a shallow flask need be used. While care is necessary in determining the method of running the job, it is equally essential in setting the risers. All thicker parts of the casting which have direct contact with the top flange should have some facility for being fed. Those parts not in contact with the top should be attended to with denseners as previously indicated, either during the ramming of the mold or in the preparation of the cores, whichever are affected. On the top flange it is necessary to set risers over the bolt hole bosses at each side of the bearings, and they should be about the same size as the bosses themselves in order that they feed the casting and do not draw. When these have been set and parting sand applied the cope may be rammed.

Castings of this type are usually wanted in quantities and it is more economical to make the molds on machines. When the pattern is prepared for molding with the flange up it can be fixed to suitable plates in a short time. The main body of the pattern can be secured to a wood or metal plate, the facings and prints being removed so that the flange comes directly in contact with the plate. The pieces which have been removed must be secured to another plate upon which the cope is to be molded. When the pattern work is specially prepared for the machine the cope plate will carry the facings and prints as indicated in Fig. 7, and guide holes for the risers are an advantage. The plate for the drag will carry the runner to form the spray for running the job.

Apart from economy the use of a machine for this class of work has other advantages, particularly when a jar-ram machine is used. The density of sand is more uniform and it is more porous than when hand ramming is resorted to, and the jolt can be varied to give the required density much more readily than is possible when the human factor is depended upon.

Special attention must be given to the production of the cores for aluminum castings, particularly when they are large and almost surrounded with metal. They should be easily disintegrated by the heat of the metal and be very porous Naturally bonded sands are not sufficiently reliable Their strength varies, therefore, their resistance to crushing is not constant It is better to use an artificially bonded sand.

The majority of the cores required for this crankcase can be made on a jar-ram core machine which produces a more freely venting core than any other method. One of the main cores is shown in Figs. 8, 9 and 10. The illustrations are shaded in to show the formation of the core when the flange is cast down. However, when casting the flange it is possible to carry many of the small cores on the main core. The dotted lines along the bottom of Figs. 8 and 9, and the added portion on the top of the core show the difference for the prints, but the bearing cores and the round cores *BB* can be formed as part of the main core when casting the flange up. The type of grid suitable for these main cores is shown in Fig. 11. It is not desirable that the grid should be too rigid, and pieces of wrought iron may be introduced with advantage. A slight variation from this form is necessary when the casting is made the other way up. The main point to remember is that only sufficient strength is necessary to enable it to support the sand and allow it to be lifted. However well the sand may be rammed, if the grid is too rigid, it will offer considerable resistance to the metal after it has been cast. This is a frequent cause of wasters. Figs. 12 to 17 illustrate some of the other cores required in the mold.

When the gate and risers have been removed from the cope after it has been rammed, the flask section can be separated and the pattern withdrawn. If the pattern is a good one, and it should be for this class of work, it should be drawn with little difficulty, whether it is drawn mechanically or by hand. With a stripping machine the draw is usually so clean that tooling is not necessary. Many foundries blacken their molds to give a better skin to the castings, a mixture of powdered soapstone and plumbago is suitable for this purpose. This is preferably applied with a camel-hair brush. After the mold is blacked and any surplus blown out, the operation of coring can be commenced. Rarely do the cores fit together without some slight rubbing. It is much more satisfactory to make a dummy set of cores in the first place and assemble them so that they can be tested for accuracy. Locating the cores in the first mold takes more time; any difficulties must be surmounted with the first one and the methods used serve for the following molds. A plan of the drag is shown in Fig. 18 illustrating the small square cores *A* for the bolt heads, which are the first to be introduced. Fig. 19 shows the shape of the mold at different sections.

Considerable care is necessary in placing the cores so that once they are set there is no need to remove them. After the square cores the core shown in Fig. 12 should be set. These are indicated by *B* Fig. 20. Then after small subsidiary cores have been set in the ends of the mold the main cores *C* and *D* Fig. 20, can be located. The subsidiary cores should be just clear of the main cores so that they can be inserted without the risk of displacing them. The cores shown in Fig. 17 are set at *E* and *G*, Fig. 20. The core *G*, it may be noted, secures the core *E* and at the same time cuts through the end flange. The remaining cores *H*, *J*, and *K* can next be inserted in the order shown. The main thing to watch when setting these cores is that their surfaces are flush with the jolt of the mold. Two sectional views of the mold with the cores in position are shown in Fig. 21. The two cores shown in Figs. 14 and 15 are the last to be set. They are inserted in the cope, and since it is possible to insert them the wrong way unless the print is checked out to prevent it, it is necessary to use care when setting them. These cores must be wired to the cope. A couple of chaplets should be set on the core *B* before closing, and though it may be considered necessary to try clays when closing the first mold, it is not essential afterward. While every attention may be given to the production of the molds to secure sound castings, the metal to be poured into them influences the character of the castings to a marked degree. Its pouring temperature should be no higher than to give the fluidity for running the job. The molten metal should show a metallic lustre after the dross has been removed, and should not be red hot. If the temperature of the metal is too high, it can be reduced by adding cold metal, without materially affecting the quality of the metal. The alloys for this class of work vary in their contents of zinc and copper. Special furnaces are now used for melting aluminum. These are preferably fired by either gas or oil which are easily regulated. It is better if the flame does not come in contact with the metal, but when large quantities of metal are to be melted this cannot be avoided, hence there is considerable loss of metal due to oxidation. Charcoal cannot be used to protect aluminum by creating a reducing atmosphere because it is absorbed to form a carbide of aluminum which shows in black patches on the casting. Zinc chloride or common salt with a little fluor spar will reduce the scum which collects on the surface.

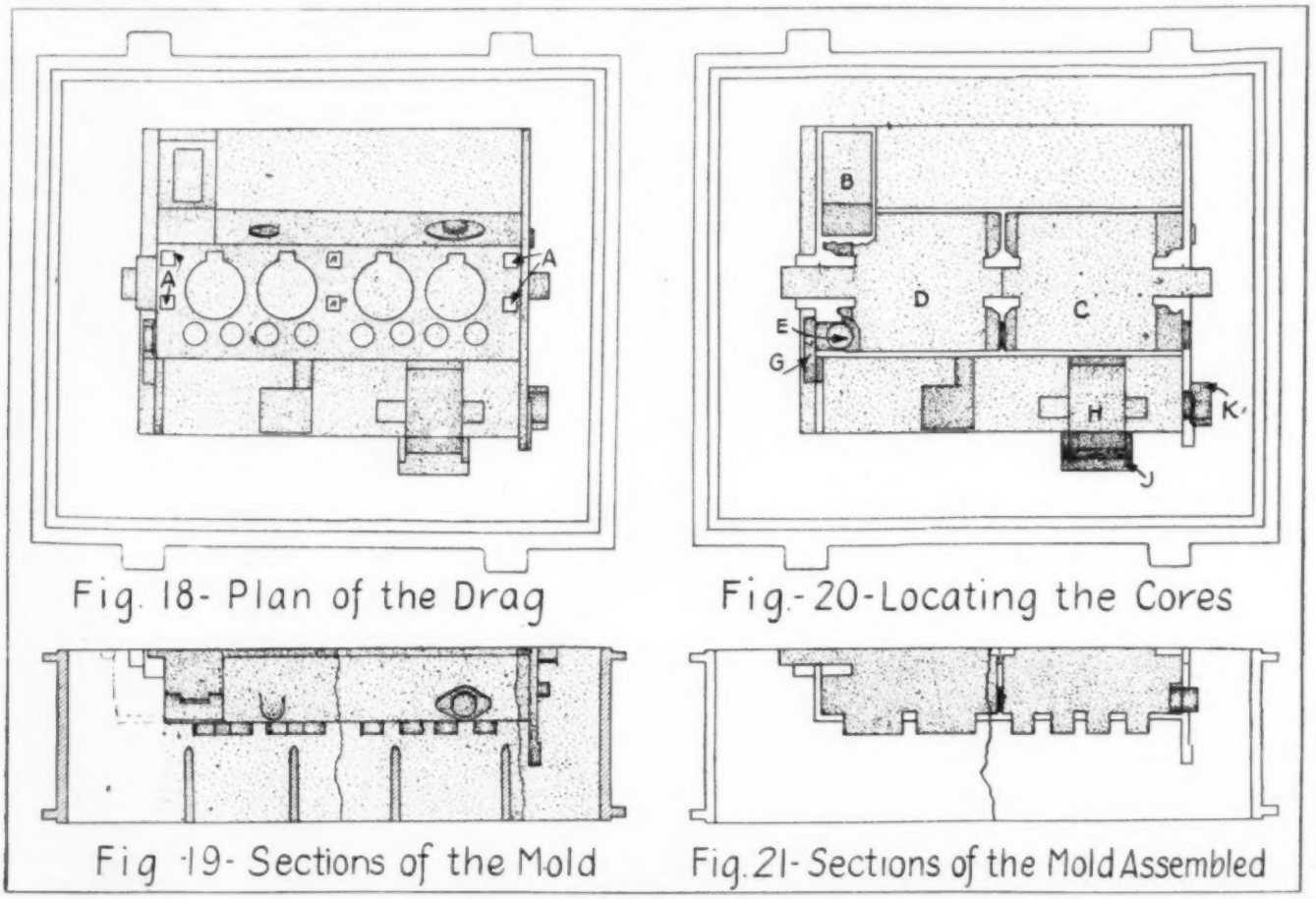


FIG. 18—PLAN OF DRAG FIG. 19—MOLD SECTIONS FIG. 20—LOCATING CORES FIG. 21—SECTIONS OF MOLD ASSEMBLED

French Molding Methods Are Rapid

Description of a New Jar-Ramming Machine Employing Hydraulic Principle—Automobile Gearcase Molded on Hydraulic Squeezer Machine in Two-Part Flask with Green-Sand Core

ONE of the most extensive and interesting displays of molding machines at the foundry equipment exhibition at Liege, Belgium, in September was that of the Societe Anonyme des Establissements Ph. Bonvillain & E. Ronceray, Choisy-le-Roi, near Paris. Among the several devices exhibited was a new jar-ramming machine to which brief reference was made in the Nov. 1 issue of THE FOUNDRY. Although electrically driven, this machine embodies an hydraulic principle which it is believed has not heretofore been applied to jolt-ramming. The machine, however, is entirely self-contained. It has been designed with the special object in view of providing a rapid machine in which rebounding of the sand is avoided. To accomplish this the machine has a short stroke and the impact is produced partly by gravity and partly through the application of power. The device therefore contains features which should make it of interest to American and other foundrymen who aim at the fast production of high-grade castings at minimum cost.

A general view of the machine with the motor and some of the moving parts exposed is shown in Fig. 1. The inside of the machine showing the operating mechanism as viewed from above is illustrated in Fig. 2. The motor is connected to the drive shaft through a spur reducing gear. The machine also may be driven by a belt from a line-shaft. Molds weighing up to about 1400 pounds may be handled readily. A pattern-drawing device of simple design may be applied. The machine has been designed with requirements of jobbing shops especially in mind, where from one to a dozen or so molds may be required from one wooden pattern, but it may also be applied to manufacturing shops doing duplicate work.

The drive shaft of the machine, shown in Fig. 1, is connected through cranks and connecting rods to the cylinder *C*. Fig. 2, which is caused to move up and down through a short range. The length of stroke is constant and the number of strokes corresponds to the speed of the shaft, about 400 per minute. The cylinder is traversed by a plunger or piston, *E*, which is enlarged at the middle so that an annular space is formed at each end of the cylinder. These two spaces are connected by channels which may be more or less choked by the screws *D*. By a convenient arrangement water may be admitted to these channels as desired. If there is no water, air passes from one end of the cylinder to the other, and the piston remains practically motionless although the cylinder may be moving at normal speed. But if water is admitted it forms a cushion between the piston and the cylinder in such a way that the stroke of the piston is altered according to the amount of water supplied. The machine works somewhat like a double acting steam hammer, the blow being obtained not only from gravity but also from the action of the cylinder pushing down through the cushion of water. The speed of 400 strokes per minute is said to be sufficient to prevent rebounding of the sand. The machine has been patented in various countries.

In addition to the new jar-ramming machine just described Ph. Bonvillain & E. Ronceray make a number of different types of hydraulically operated squeezer machines which are especially adapted for handling duplicate work such as is found in automobile casting shops. Among the several machines of this kind shown at Liege was one of the rollover type for deep complicated work which was fitted up for molding an automobile gearcase in a two-part flask. The interesting feature of this job is that with the exception of two plain round cores and

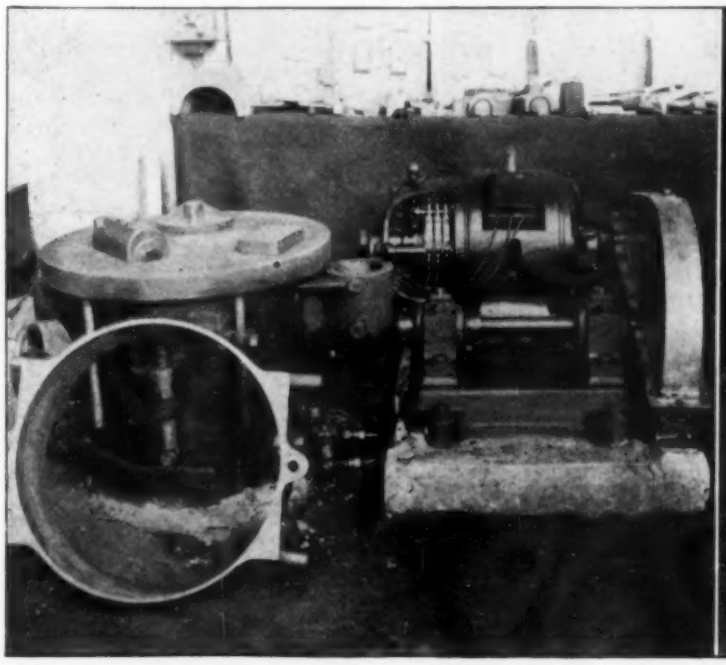
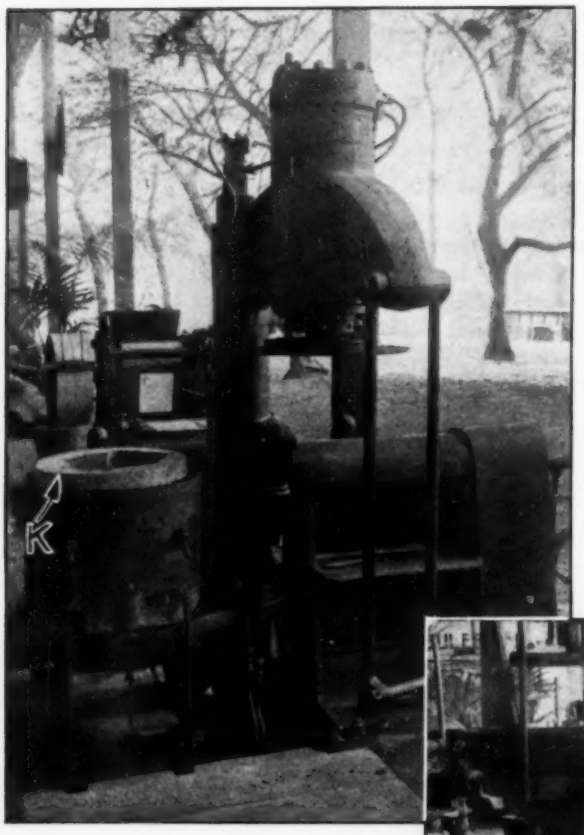
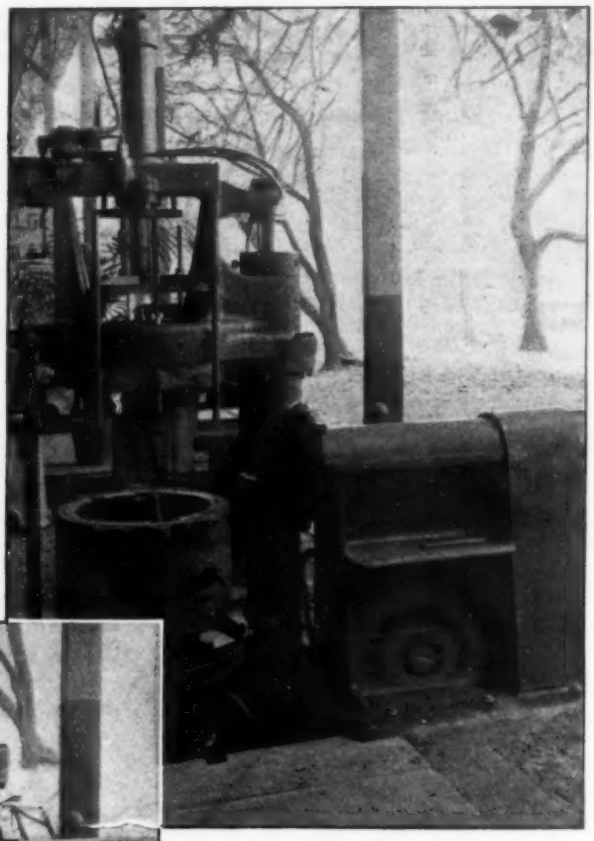


FIG. 1—THIS ELECTRICALLY DRIVEN JAR-RAMMING MACHINE UTILIZES AN HYDRAULIC PRINCIPLE FIG. 2—INTERIOR TOP VIEW OF MACHINE SHOWING CYLINDER, PISTON AND SCREWS FOR CHOKING WATER CHANNEL





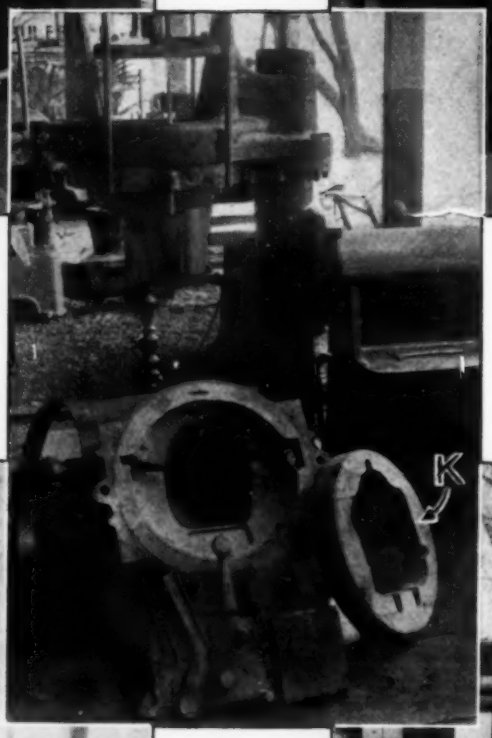
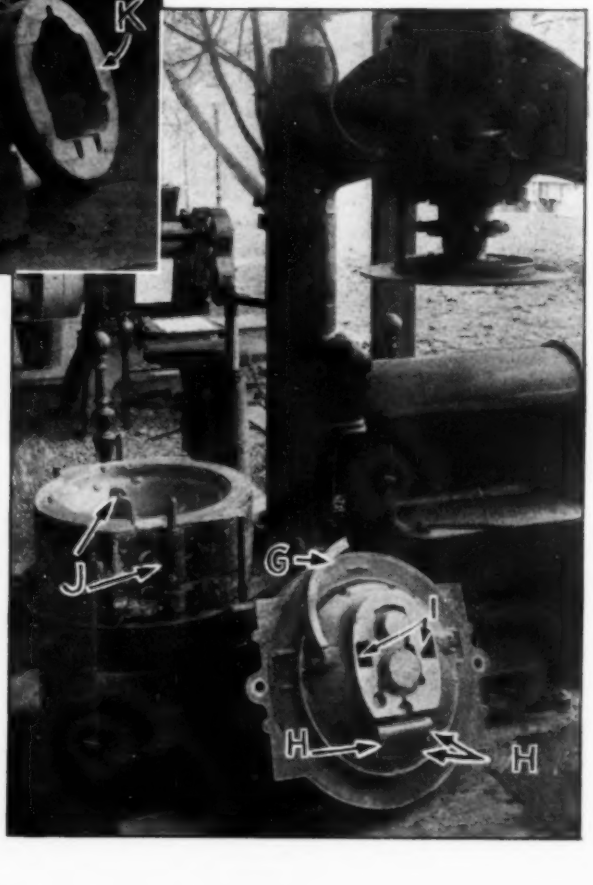


FIG. 3 — ABOVE — RAMMING COLLAR IN PLACE FOR SQUEEZING DRAG MOLD OF AUTOMOBILE GEAR CASE FIG. 4 — BELOW — COPE ROLLED OVER AND PATTERN PLATE WITHDRAWN FIG. 5 — CENTER — PATTERN HAS SEVEN LOOSE PIECES

FIG. 6—ABOVE—SAME MOLD AS THAT SHOWN IN FIG. 3. ROLLED OVER WITH THE PATTERN DRAWN FIG. 7—BELOW—DETAIL OF THE COPE WITH THE PATTERN PLATE ON THE MACHINE



one enclosed core all dry-sand coring has been eliminated, the main body core being green sand suspended from the cope.

The machine used, as shown in Figs. 3 to 7 is of the swinghead hydraulic squeezer type so constructed that the entire ramming mechanism, also carrying the mold, may be rolled over bodily for drawing the pattern after squeezing. Figs. 3, 5 and 6 show successive stages in ramming the drag part of the mold, the molding of the cope being shown in Figs. 4 and 7. In the demonstration tests at Liege the drag was molded in 8 minutes and 18 seconds and the cope in 3 minutes and 41 seconds, the pattern having seven loose parts in one plate and six in the other, making 13 in all.

The drag is shown ready for ramming in Fig. 3, with the ramming block *K* in place. After rolling-over and drawing the pattern the job appears as in Fig. 5 while Fig. 6 the mold, the ramming block and some of the loose parts of the pattern which of course are drawn by hand. These loose parts are necessary on account of the irregular profile of the casting, including various bosses, etc. The drag is about 15 inches deep. It is rammed by two strokes of the machine, the first stroke being made through the ramming block *K* in order to properly ram the sand in the lower parts of the mold. No peg ramming under the bosses or projecting parts is necessary, and the density of ramming on the machine may of course be varied at the will of the operator. A small amount of hand tucking is required in one or two places. A circular cast iron flask about 20 inches in diameter and 18 inches deep is employed.

The cope is only about 4 inches deep with the projecting green sand core extending about 5 inches below the parting. The interior of the pattern plate and the finished cope-mold are shown in Fig. 7. The machine is shown rolled-over and the pattern drawn in Fig. 4, another finished mold being seen on the stool at the right.

In Fig. 7 one of the seven loose pieces has been taken out and is shown at *G*. Four of these parts are used to form a recess all around the mold, while the other three form the undercut portions of the mold illustrated at *H*. Fig. 7 also shows the two projecting ears *I* which contain round cored holes. To form these holes two rods *J* are fitted through the pattern plate. Tubes of an inside diameter corresponding to the diameter of the rods are inserted between the ears *I* and the sand rammed around them. When the mold is completed, but before drawing the pattern, the rods *J* are drawn out leaving an accurate guide through which the cylindrical cores can afterward be slid into position.

Core boxes are eliminated, and fins due to core displacement are obviated. The pattern plates are made from master patterns by ordinary molders without the help of machinists or fitters, the plates being cast from a white metal mixture of lead and antimony. The shrinkage of the white metal is compensated. The plates when necessary are backed by plaster and cement, this method of making pattern plates without machining having been developed by Bonvillain & Ronceray.

Establishes Local Offices in New York

The Whiting Corp., Harvey, Ill., manufacturer of cranes, foundry equipment and railway specialties, will establish its own New York City offices at 136 Liberty street on March 1. The company has been represented in the East by the Wonham, Bates & Goode Trading Corp., 251 Fourth avenue, New York City. J. Ross Bates and D. P. Plederman, both of the Wonham company, will be associated with the Whiting offices. Mr. Bates being in charge.

Making Packard Auto Castings-I

(*Concluded from Page* 135)

cupies nearly one third of the floor area. Contrary to usual foundry design and practice, it neither is housed in a separate building nor even partitioned off from the iron molding floors on one side or the nonferrous molding floors on the other. With the exception of the space occupied by the ovens and by a wide gangway on either side, the work benches are arranged back to back and extend from one side of the floor to the other. Wide spaces between the groups of benches serve as supplementary gangways and floored with smooth concrete facilitate the work of the automotive trucks employed in transporting the core racks to and from the ovens.

On account of the extreme accuracy desired and also because they are in constant use, all the coreboxes are made of cast iron. Some are quite simple, but others are extremely complicated and represent a high degree of skill and foundry knowledge on the part of their designers. The majority of the cores indicated by a typical set of cylinder cores to be shown in the succeeding installment of this article, are light, fragile and intricate. They must be reinforced with numerous wires and vented at definite points and since the actual ramming of the sand probably is one of the least important of the factors involved from a time saving basis nearly all of these cores are rammed by hand. However, several plain, hand-bumper machines are provided for making several of the plain shapes. The barrel cores, which are not rodded, are rammed on end in a quadruple core box on a power-operated, plain jarring machine.

Pickling Solutions for Iron

By H. E. Diller

Question: We are experiencing trouble removing core sand from the inside of pistons and as we do not have any sand blast we would like to know the formula for a pickle which would take the sand out of these castings.

Answer: Pistons probably could be cleaned cheaper by tumbling than by pickling, but if you wish to pickle them two pickles are available. The one would dissolve the sand but would not dissolve any iron. This pickle is made by mixing one part strong hydrofluoric acid with eight parts of water. Another pickle is made by slowly pouring one part concentrated sulphuric acid into eight parts of water. Care must be used in doing this as heat is generated by the union of the two and may cause the solution to splash and boil. In no case should the water be poured into the acid. This pickle dissolves the iron and loosens the sand. It is therefore essential that castings be not kept in this solution longer than necessary to clean the sand from the castings.

In both cases the pickle should be kept heated, preferably with steam coils or by running steam directly into the solution. After the castings are taken from the pickle they should be washed in running water.

Opens Pittsburgh Branch

The arrangement whereby the George J. Hagan Co. represented the Combustion Engineering Corp., at Pittsburgh, has been discontinued and the Combustion Engineering Corp. has opened its own office in the First National Bank building, Pittsburgh, in charge of W. C. Stripe, who also will have charge of an office to be opened by the Combustion Engineering Corp., in Cleveland. Mr. Stripe formerly was manager of the Combustion Engineering Corp. office in Philadelphia. The George J. Hagan Co. will retain the exclusive agency for stokers made by the Combustion Engineering Corp., for use in Hagan industrial furnaces.

Cupola Is the Heart of the Foundry

Shape of Lining and Ease of Operation, Size and Location of Tuyeres, Blowing Units and Volume of Air Required Are Some of the Subjects Considered

BY J. R. HEDGES

THE Southern Metal Trades association has appointed a research committee whose duty shall be to prepare reports on various phases of the metal industry so that members engaged in one line may become acquainted with all. The first report prepared and submitted deals with the manner in which the cupola should be operated to secure the most satisfactory results. It explains that the cupola is divided into four zones: The first or crucible zone extending upward from the sand bottom to the lower side of the tuyeres. The tuyere zone where the blast comes into contact with and burns the fuel is next in order. The third or melting zone where all the melting takes place is situated just above the tuyere zone. Its upper limit depends on the height of the fuel bed and never should be allowed to extend more than from 15 to 25 inches above the upper edge of the tuyeres. This factor will depend upon the size of the cupola and the quality of the fuel. The iron should start melting as it falls toward the melting zone and should be completely melted at a point about 4 to 8 inches lower. The iron and coke will sink as the latter burns away. The upper or charging zone extending from the melting zone to the level of the charging door is that space where the coke and iron absorb heat so that by the time they reach the melting zone the iron immediately will begin to melt. The cupola as nearly as possible should be kept filled to the charging door until the necessary amount has been charged for the heat.

The tuyere zone, acting as a governor, is the most important of the four. The size of the tuyere openings depends on the diameter of the cupola inside the lining, the height of the charging door and the total height of the stack. In small cupolas the charging door should be three or four times the diameter above the tuyeres. In cupolas over 60 inches in diameter this proportion may be considerably reduced. The tuyere area approximately should equal one quarter of the cupola area at the melting zone. To determine the area of each tuyere, divide 25 per cent of the cross sectional area by the number of tuyeres desired. The form of the tuyeres is a matter of minor importance, but they should be large enough to admit a sufficient quantity of air measured by volume and not by pressure. They should be spaced evenly and located at a height above the bottom that will conform to the class of castings to be handled.

Location of Tuyeres

In stove foundry, says the report, the cupola tuyeres should be from 4 to 12 inches above the sand bed, depending on the size of the cupola. In machine and jobbing foundries they may be located higher depending on the amount usually required at one tap. Cupolas with high tuyeres, from 1 to 2 feet, depending on the size of the cupola, will melt more and run longer heats than those with low tuyeres. On short heats it is advisable to use low tuyeres to save fuel. The iron and slag may both be drawn from the tap hole and allowed to run into a mixing ladle. In general, high tuyeres are more satisfactory where the heats run over 2 hours. Upper tuyeres are not necessary if the lower tuyeres are large enough to admit the proper volume of air. Upper tuyeres involve use of additional fuel on the bed.

The inner ends of the tuyeres should be flared so that when in position in the cupola the flared ends form a practically continuous opening. The inner end should be protected by about 2 inches of overhanging brick work so that the molten iron dropping down from the melting zone will not burn them.

The cupola lining should be built straight up and down from the tuyeres to the top of the stack; or at least as far as the charging door. Where a cupola is equipped with a double lining there is no need of carrying it past the charging door. In fact there should be no need of carrying it past the melting zone if it were not for the importance of maintaining a straight wall to prevent the charge from scaffolding or hanging up.

Some foundrymen advocate a lining smaller at the tuyeres than at the charging door, to save coke on the bed. Except in large cupolas this practice involves danger of bunging up the cupola according to the committee statement. Straight linings yield better results including a clean drop when the heat is over.

Theoretically, 30,000 cubic feet of air are required to melt one ton of iron. Great care should be exercised in selecting the proper size fan or blower. In figuring the speed and capacity, 10 per cent excess should be allowed to compensate for friction loss and leaks. Blower and fan catalogs

Diameter of Blast Pipes for all Cupolas from 18 to 84 inches

Diameter of cupolas Inches	Diameter of pipe Inches	Diameter of cupolas Inches	Diameter of pipe Inches	Diameter of cupolas Inches	Diameter of pipe Inches
18	5	41	11½	63	17¾
19	5¼	42	11¾	64	18
20	5⅜	43	12	65	18¼
21	6	44	12½	66	18½
22	6¼	45	12¾	67	18¾
23	6½	46	13	68	19
24	6¾	47	13¼	69	19½
25	7	48	13½	70	19¾
26	7¼	49	13¾	71	20
27	7¾	50	14	72	20¼
28	8	51	14½	73	20¼
28	8¼	52	14¾	74	20¾
30	8½	53	15	75	21
31	8¾	54	15¼	76	21½
32	9	55	15½	77	21¾
33	9¼	56	15¾	78	22
34	9½	57	16	79	22¼
35	9¾	58	16¼	80	22½
36	10	69	16½	81	22¾
37	10½	60	16¾	82	23
38	10¾	61	17	83	23¼
39	11	62	17½	84	24
40	11¼	..	..	..	..

The author, chairman of the research committee appointed by the Southern Metal Trades association, is a member of the firm Casey-Hedges Co., Chattanooga, Tenn.

indicate the amount of air displaced per minute or per revolution. Knowing the amount of air required to melt one ton of iron and also knowing the rated melting speed of a given cupola it is relatively simple to select a suitable blower. The size of the blast pipe exercises considerable influence on the efficiency of the blower. The distance from the blower to the cupola should not exceed 50 feet. Over this distance the diameter should be increased. Baker's summary showing diameter of blast pipes for cupolas from 18 to 84 inches diameter is shown in the accompanying table.

More accurate readings will be secured by placing the blast pressure gage on the wind box instead of on the blast pipe. It is impracticable to get the pressure on the inside of a cupola, but the gage on the windbox will approximate it more closely than if the gage were placed on the blast pipe. The pressure on cupolas up to 46 inches diameter should range from 8 to 12 ounces; on larger cupolas from 12 to 16 ounces. The pressure will vary as the material settles but should not exceed the figures indicated.

The pressure is not as important as the volume of air entering the cupola. If the blower and pipes are properly designed and proportioned and if the air pressure does not exceed 12 to 16 ounces as given for various sized cupolas it is fairly conclusive evidence that the tuyeres are large enough and that a sufficient volume of air is being delivered. For contrast, where the blower and blast pipe are correctly proportioned; but where the tuyeres are too small, the air will enter the cupola at high pressure and burn the life elements out of the iron, increase the sulphur, make more slag, consume more fuel and by burning the silicon out of the iron necessitate the use of a higher grade of pig iron. A large volume of air delivered at low pressure will produce better iron and at a lower cost than where high pressure obtains.

British Institute Dates Are Announced

The annual meeting of the British Institute of Metals will be held in London, March 8 and 9, at the Institution of Mechanical Engineers. The annual dinner will take place Wednesday evening, March 8. The annual May lecture of the Institute of Metals will be delivered Wednesday, May 3, at the Institution of Mechanical Engineers, London, by Sir Ernest Rutherford on the "Relation of the Elements." The fall meeting of the Institute will be held at Swansea, South Wales, Sept. 20-22, 1922.

British View of Semisteel

To the Editor: We note in your editorial in the Jan. 1 issue of THE FOUNDRY that 1.8 per cent carbon has been obtained in cupola melted semisteel. This is contrary to our experience and we would like to know how such low carbon was obtained. While connected with the Ministry of Munitions we made many tests of semisteel and none of these tests showed less than 2.8 per cent carbon. We made a series of experiments using as high as 98 per cent steel in the cupola and never obtained less than 3 per cent carbon. The cupola which we used in these experiments was small and therefore offered every chance for carbon absorption.

J. Shaw

Sheffield, England.

EDITOR'S NOTE

Semisteel with 1.8 per cent carbon was obtained from a mixture consisting of 45 per cent ferrosilicon with less than 2 per cent carbon, and steel scrap with less than 1 per cent carbon. The metal was melted in large heats in a cupola lined to 60 inches inside diameter. The proportion of coke to iron was low, so an excess coke which would increase the absorption of carbon was not used. As was stated in the editorial, the first of the heat was high in carbon and the iron contained less carbon as the heat progressed until at the end of a long heat the carbon was sometimes as low as 1.8 per cent.

Analysis of Ingot Molds Important Factor

By James Thomas

The active life of an ingot mold depends almost exclusively on the analysis of the iron of which it is composed. When proper care is taken of them in the steel plant, ingot molds poured from direct blast-furnace iron showing an analysis of silicon 1.25 to 1.60 per cent, and sulphur 0.025 per cent, manganese 0.90 to 1.10 per cent, phosphorus under 0.15 per cent, will stand from 100 to 135 heats before they are scrapped. The average direct metal ingot mold poured from iron within the standard bessemer limits of analysis gives satisfactory results.

Experiments have been tried by melting steel in an electric furnace and adding it in the proportion of 10 per cent to the direct metal in the ladle. The most pronounced result was the manner in which the addition of the steel cleared the ladle of all the kish or free carbon. Fracture of this metal when cold resembled fine-grained cupola iron. Ingot molds made from this iron, although low in sulphur, did not show up as well in service as those made from straight bessemer iron.

Where it is necessary to melt iron for ingot molds in a cupola, the best results are obtained from charging pig iron of the following analysis: silicon 2.00 to 2.25 per cent; sulphur under 0.025 per cent; phosphorus 0.15 per cent or under; manganese 1.00 to 1.50 per cent. All return scrap is used daily and if foreign scrap is employed a suitable addition of 10 per cent ferrosilicon may be added to the charge to preserve uniformity. A satisfactory active life of a mold does not lie entirely either in the way it is made or in the analysis of the iron. Proper care at the steel plant where it is used, also is essential. Annealing the larger molds, thus relieving the internal strains before they are placed in service exerts a favorable influence and prolongs the life of the mold to a considerable extent.

Model Foundry for the Birmingham Show

One of the features of the foundry exhibition which will be held in Birmingham, England, June 15 to 24, under the auspices of the Institution of British Foundrymen and the British Cast Iron Research association, will be a model foundry. The underlying idea is to show a small foundry which is 100 per cent equipped with modern labor-saving machinery. Various British manufacturers and exhibitors are co-operating to fit out this feature of the show.

Another feature of the exhibition will be special arrangements for the showing of motion pictures illustrating foundry operations and other industrial subjects. This opportunity to display films is believed to be a special benefit to American and other foreign exhibitors who might not be able to show actual samples of heavy machinery. Applications for space at the Birmingham exhibition are coming in rapidly.

A Correction

Through a typographical error on page 65 of the Jan. 15 issue, a statement was made that J. W. Paxson Co., Philadelphia, has occupied a recently completed modern factory building at Nicetown and D Streets, Milwaukee. Obviously this should have been Philadelphia. The J. W. Paxson Co. is one of the largest manufacturers of foundry machinery, supplies and facings and has been in business in Philadelphia since its establishment.

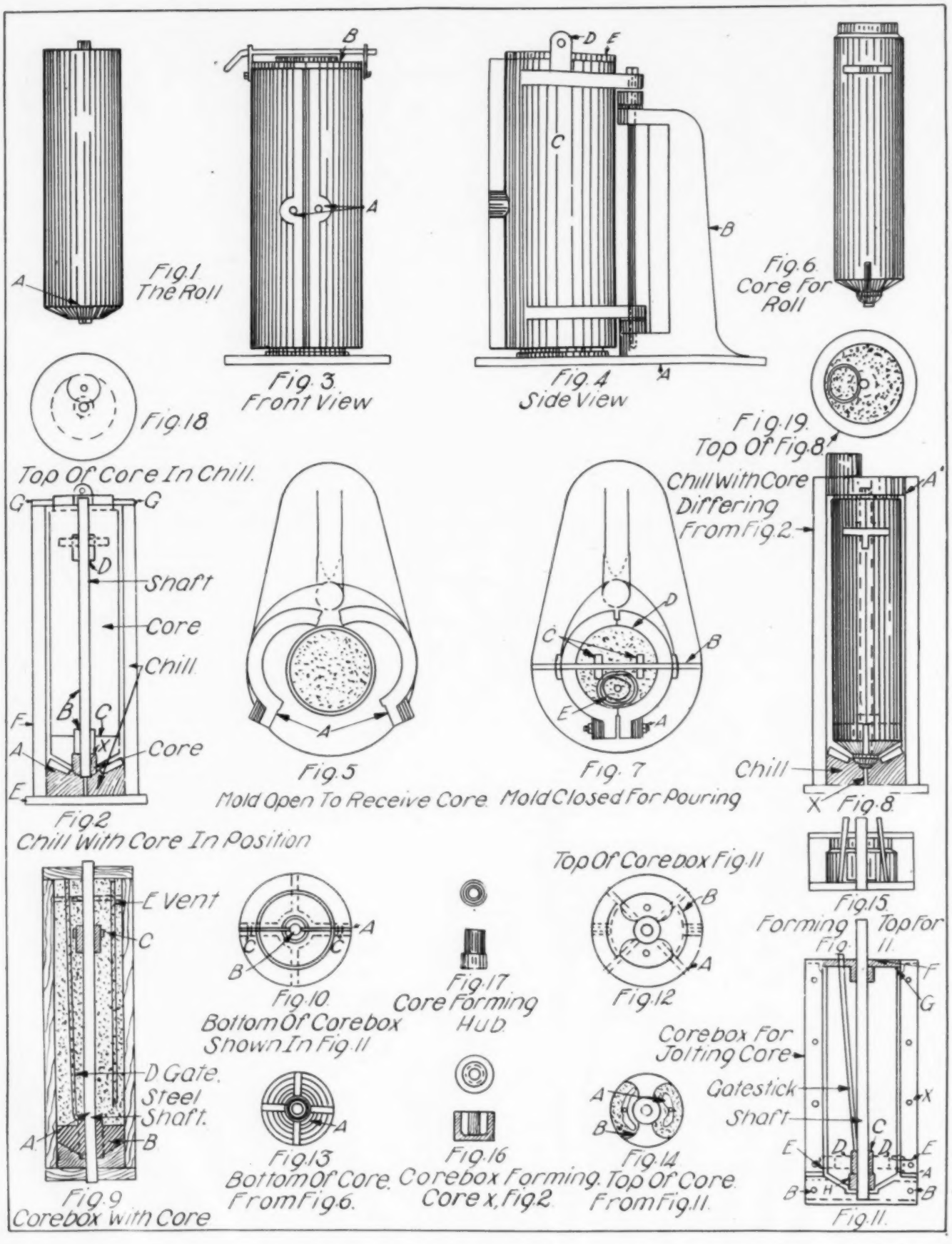


FIG. 1—CORED ROLL FIG. 2—CHILL WITH CORE IN POSITION FIGS. 3 AND 4—FRONT AND SIDE VIEW RESPECTIVELY OF CHILL FOR ROLL FIG. 5—MOLD OPEN FIG. 6—CORE FOR ROLL FIG. 7—MOLD CLOSED FOR POURING FIG. 8—CHILL WITH CORE DIFFERING FROM FIG. 2 FIG. 9—COREBOX WITH CORE FIG. 10—BOTTOM OF COREBOX FIG. 11—COREBOX FOR JOLTING CORE FIG. 12—TOP OF COREBOX FIG. 13—BOTTOM OF CORE FIG. 14—TOP OF CORE FIG. 15—CORE FORMING TOP FOR FIG. 11 FIG. 16—COREBOX FORMING CORE *X*, FIG. 2 FIG. 17—CORE FORMING HUB FIG. 18—TOP OF CORE IN CHILL FIG. 19—TOP OF MOLD SHOWN IN FIG. 8

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form

ROUTINE ANALYTICAL METHODS

(*Continued from Data Sheet No.* 416)

Notes and Precautions—Using the method of preparing the sample advocated and the weight given, the foregoing method will give accurate results on all ordinary gray irons. The sampling obviates any errors which might arise from segregations in small samples. Duplicate determinations generally run within 0.01 per cent plus or minus in a 0.75 per cent phosphorus sample.

This method is somewhat less tedious and less subject to variations than other volumetric methods. The *molybdate-pyrophosphate* method is recommended for all *ultimate* standardization.

In all methods involving titrating or weighing the yellow precipitate the method must be carried out the same from day to day, as variations may cause changes in the composition of the precipitate.

Sodium nitrite ($NaNO_2$) or tartaric acid may be used as a reducing agent in place of ferrous sulphate.

Less molybdate causes more time for complete precipitations. More shaking produces quicker precipitation. The partial neutralization of the excess HNO_3 by ammonia also promotes quicker precipitation. Some grades of molybdic acid (or really ammonium molybdate, 85 per cent MO_3) are quicker in dissolving and produce a more granular precipitate quicker than other grades.

Phenolphtalein indicator in alcohol—this solution picks up CO_2 from air and becomes acid, therefore, for accurate work, it should be neutralized to a faint pink with NaOH.

A $\frac{N}{5}$ solution will give a little over 0.05 per cent phosphorus per c.c. factor on a 0.5 gram sample. If desired, the solution can be diluted to get an even factor. The theoretical value is 1.0 c.c. $\frac{N}{5}$ NaOH is equivalent to 0.00027 gram phosphorus.

DETERMINATION OF TOTAL CARBON

Principle—The carbon in gray iron occurs in 3 structural forms, graphite, or free carbon, free cementite (combined carbon, Fe_3C) and pearlite, which is the eutectoid of ferrite (iron) and cementite (iron carbide). In hypoeutectoid cast iron (0.80 per cent combined carbon or below) all but a trace of the carbon ordinarily occurs as graphite and pearlite. The accurate methods for determining graphite and total carbon depend on burning the carbon to carbon dioxide in a stream of oxygen, absorbing the resultant carbon dioxide (CO_2) and weighing it. The method for combined carbon in *normally cooled* cast iron depends on the color given to a dilute nitric acid solution by the dissolved carbides.

(*Continued on Data Sheet No.* 418)

ROUTINE ANALYTICAL METHODS

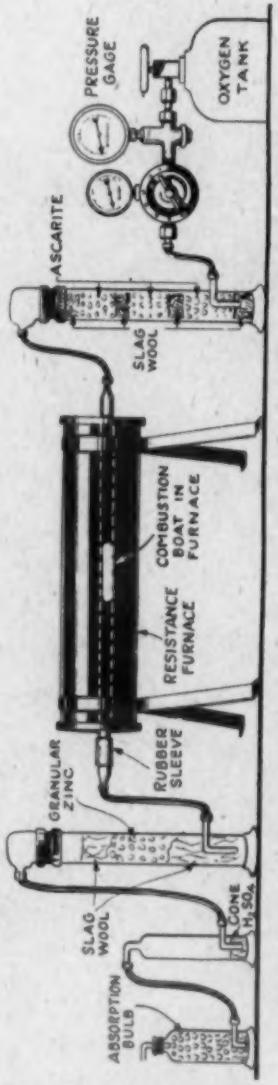


FIG. 5—OXYGEN IS PASSED THROUGH ASCARITE BEFORE ENTERING THE COMBUSTION FURNACE —THE GAS WITH THE CO_2 PASSES OVER GRANULAR ZINC AND THE MOISTURE IS ABSORBED IN CONC. H_2SO_4

(*Continued from Data Sheet No.* 417)

Combustion Train—Fig. 5 shows the essential features of the combustion train. After using several types of trains, absorption tubes, refractory tubes, etc., this was judged to be *fastest, simplest* and *most accurate* for the work. All connections are of glass or rubber tubing. *The fewer the connections, the better.*

Standardization—After setting up the train put a little glass wool or clean slag wool around the inlet tube of the midvale bulb and fill with ascarite (sodium-hydrate asbestos mixture) tamping lightly. Adjust the oxygen flow at 250 c.c. per minute or over according to time allowed for combustion of the sample. Pass oxygen through the bulb for 1 hour. Place some ignited silica sand on the bottom of a clay boat. While clay boats are recommended, silica, alundum, porcelain or platinum boats may be used. Evenly distribute a 1-gram standard sample in the boat and place it in the furnace for 8 to 10 minutes after attaching a weighed absorption bulb. Remove and reweigh. The second or third determination will check if everything in the train is correct and all joints tight. A blank determination should be run on the bulb, and should show only a negligible increase in weight in 10 minutes.

(*Continued on Data Sheet No.* 419)

Diverse Methods of Roll Molding

Rolls Cast in Solid Chills or in Split Chills Swung on Supporting Columns—Some Poured on End and Others on Side—Various Methods of Gating Are Described

BY R. H. PALMER

INCLUDED among the castings iron foundries are called upon to furnish to machinery manufacturers are a great variety of cast-iron rolls of many weights, designs and sizes. Some of these rolls are cast in loam and dry sand, when particularly clean solid castings without blemish are required. Others which must be extremely hard are cast in chills or iron molds and are finished by grinding. Again certain rolls have the center cored out by a core which has a shaft arranged in the center in such a way that the shaft will remain in the casting when the core is removed. In other cases a steel shaft is cast in the center of a solid roll.

To those who have had no experience with casting rolls it may seem an easy matter to produce these castings. But the contrary is true, for many trials and experiments often must be made to obtain a satisfactory roll. The arrangement of gates, risers and shrinkheads must be varied to obtain the desired result and the iron which is poured into the mold must be of the correct composition and carefully melted. Also when the center of the roll is cored leaving a light cross section, or a long roll is cored yet has a shaft cast in it extending through the center, or when casting a long slim solid roll on end, a study must be made of expansion and contraction, heating and cooling, and means must be taken to prevent the roll from cracking as it cools. Then the roll may be of the required density, apparently solid and clean but if it is a long slim roll, it may be so warped that the amount of finish allowed is not sufficient to permit the roll to be cleaned up.

Sometimes a roll cast on the side is sound everywhere but where the iron meets after it flows up each side over the core. At this point a few bubbles or blow holes which are too long to be plugged, if plugging is allowed, form and cause the roll to be condemned.

The accompanying sketches show some ways of molding different types of rolls and illustrate points to consider when casting them. The roll shown in Fig. 1 is known to lumbermill men as a *live* or *dead* roll depending on how it is used in the mill. These rolls for many years were cast in green-sand molds, later the teeth to receive the pinion gear, shown at *A*, Fig. 1, were cast in a cast-iron chill, shown at *A*, Fig. 2. Still later, cast-iron molds or chills, Fig. 3, were used to form the roll. Fig. 4 is a side view of the iron mold we will call the *chill*. The base, *A*, Fig. 4, and the upright supporting column are cast in one piece. The two parts forming the roll, *C*, Fig. 4, are shown at *A*, Fig. 5, swung open to receive the core, Fig. 6. The chill, *A*, Fig. 2, is placed on the base and the core is set in it. Then the sides of the mold are swung together, the top of the chill closing around the core and the bottom around the chill forming the teeth. The chill is bolted together in front as indicated at, *A*, Fig. 7. A front view of the finished mold is shown in Fig. 3, and a top view in Fig. 7.

A rod, shown at *B*, Fig. 7, is run through holes in the ears on the sides of the chill, *D*, Fig. 4, and wedges, *C*, Fig. 7, are placed over the core, *D*, Fig. 7. Then the sand runner, *E*, Fig. 7, is set in place. Holes are arranged in the chill as shown at *A*, Fig. 3, to insert bars to throw the chill apart. The operation of making the core is described later.

With this type of chill a number of rolls may be cast in a heat if a few extra chills for forming the teeth are used. But if too many are cast at one heat the life of the chill is shortened as this will tend to overheat the chill and cause the inside surface to become checked. Before becoming too badly checked, the chills can be rebored as they usually become a little small in the bore through use.

The pieces bolted to and forming the top of chill for closing around the top of the core, indicated at *B*, Fig. 3, and *E*, Fig. 4, give more or less trouble when casting although the chills are heated before use. The gas and some steam from the cores rise and collect on the under side of these plates which form the top of the chill. Thus when the mold is being filled the iron on rising to these plates is blown away from them, and gas holes are formed. Therefore with this arrangement it is important that the chill be well heated.

The composition of the iron poured in the rolls cast in iron chills has much to do with the length of life of the chill as well as the quality of the casting, and it is so with all castings made in cast-iron molds. If soft iron having a higher fluidity is poured into these castings, the iron can be poured at a lower temperature and then the face of the chill will not be attacked as it would be with an iron having a lower fluidity and requiring to be poured hotter. As soon as the casting is set sufficiently after pouring, the mold is thrown apart and the casting removed. The chill may then be set up for another casting. The casting being red hot, anneals the skin on the outside.

Fig. 2 shows the core with the shaft, *B*, which remains in the casting when the core is removed, as well as the lower hub and arms, *C*, and the upper hub and arms, *D*. If the iron is too hard and the roll is quite long the iron setting up too quickly will cause the roll to have a jagged crack, or pull, next to the arms. Also as the end of roll against the chill forming the teeth is cast with a key in the hub to insure that the distance from the end of the shaft shall be the same in all rolls, the hub on the other end must slip on the shaft when cooling.

This end gave trouble as the hub would not slip and the casting cracked when the shaft was used rough turned. A finishing cut and a light coat of blacking on the shaft solved the difficulty. This was especially noticeable in the rolls 40 to 60 inches in length. Fig. 2 shows a different method of molding the roll than is indicated in Figs. 3, 4, 5 and 7.

In the type of chill used in this case the base, *E*, Fig. 2, has the chill *A* placed on it for forming the gear teeth. The chill is a piece of pipe or cylinder. The core, Fig. 6, is set in the toothed chill, *A*, Fig. 2, and the chill *F* is lowered down, sliding by the toothed chill and resting on the base plate, *E*. The pieces *G G* are loose and pinned on top of chill with stubbed pins having a short pitching taper which guides them into place and centers the core. This core is held, as indicated in Fig. 3, with rod and wedges and also the two plates *GG*, Fig. 2.

The mold shown in Fig. 8, will produce the same kind of a casting as the one shown in Fig. 2, but is arranged

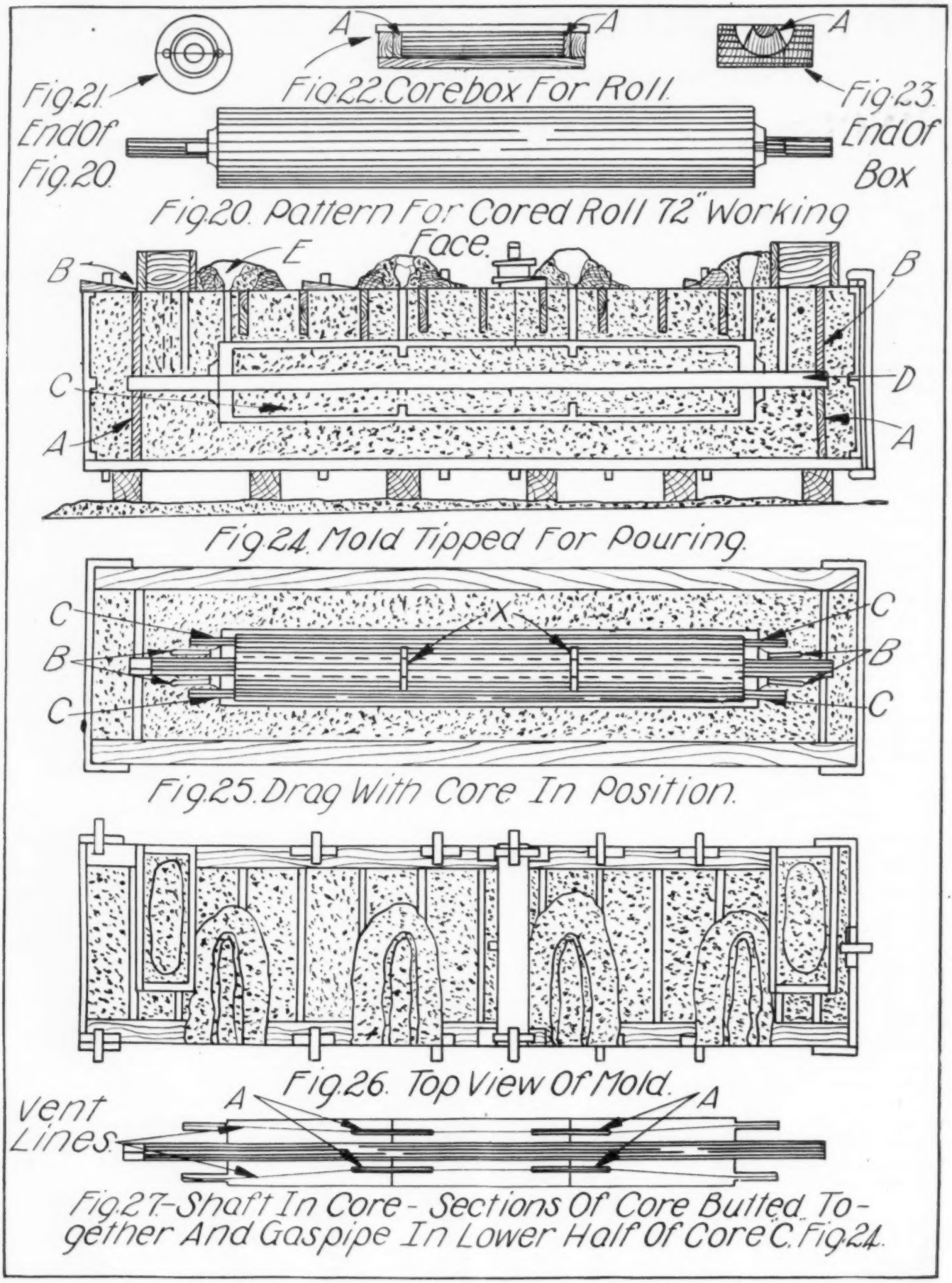


FIG. 20—PATTERN FOR CORED ROLL, 72-INCH WORKING FACE FIG. 21—END OF FIG. 20 FIG. 22—COREBOX FOR ROLL FIG. 23—END OF COREBOX FIG. 24— MOLD TIPPED FOR POURING FIG. 25—DRAG WITH CORE IN POSITION FIG. 26—TOP VIEW OF MOLD FIG. 27—SHAFT IN CORE

differently as the top of the core must slide into the chill, fitting snugly. When the mold fills, the iron flows up against the core at *A*, Fig. 8, which has a few cuts arranged in the sides at the top so gas cannot be pocketed.

It is important no burr is left on the ends of shafts entering the chill forming the teeth and that the top of the hole receiving the shaft shall be beveled slightly to help guide the shaft into its seating. The hole *X*, Figs. 2 and 8 allows a rod to go through the chill so the casting can be freed if the toothed chill sticks as it often does.

When using the chill illustrated in Fig. 8, if a longer casting is required, an addition to the chill can be bolted to the top and a longer roll cast, care being exercised that the addition shall be a perfect fit to the top and inside of the other portion of the chill.

The method of making the core for the rolls shown in Figs 2, 3, 4, 5 and 7 is indicated in Fig. 9. This core is made in two halves. The portion cut out to receive the shaft is shown, and the part of core box forming the lower arms is indicated at *B*, while the part of corebox forming the upper arms is drawn from the core after it is rolled over. The core plates are shown at *C*. The gate is cut at *D* and vent at *E*.

When the two halves have been baked, the shaft is placed in one half and set to measurement. The other half is rubbed on it until the core calipers the right size when it is pasted, slurried, wired, bound, blackened and dried.

Rubbing cores together and callipering them to the desired size, as well as pasting, slurrying and bending them requires considerable time, so when cores can be produced whole it is cheaper to make them that way even though the first outlay is more expensive.

With this end in view and so that the cores could be jolted up, the bottom of the core was made as shown, Fig. 10, split in two parts of the line *A*. It also may be noted from this illustration that the two halves do not come together. The two halves are placed side by side and the shaft to be cast in the roll is placed in *B*. The cross section of this bottom is shown at *A*, Fig. 11. Bolts are put through holes shown at *B*, Fig. 11 and *C*, Fig. 10. On tightening the bolts the two halves, Fig. 10, are clamped or squeezed on to the shaft, thus the circle is formed which is to receive the upper part of this box shown at *X*, Fig. 11. This section is made in two halves and bolted together. The cast-iron print, *C*, Fig. 11, is slipped down on the shaft, resting in *A* and the pieces forming the arms around the lower hub, *D*, Fig. 11, also Fig. 12, *A* are placed extending through *X* at *E*, Fig. 11. The part of the corebox forming the upper arms, *F*, Fig. 11, is slid down on shaft resting in shoulder shown at *G*, Fig. 11 *B*, Fig. 12.

Sand of such a mixture that it will vent off easily and quickly is put in the corebox to height of hub *C*, Fig. 11, with rods having bent ends, like short-toed gaggers. Then a gate stick is set in the hole at *C*, and the box is filled with sand and jolted up on machine. The sand is struck off and parting made at *F*, Fig. 11. Two gates are cut as indicated at *A*, and *B*, Fig. 14, and after the core is vented the gate sticks are drawn. The gate *B*, Fig. 14, is cut to the upper arms because when with only the lower gate the iron in filling the mold flows into the top arm a second of hesitancy would be developed in the upward flow of the iron while the upper arms are filling causing a mark on the surface of casting. The lower arms are drawn. It may be seen that arm, *D*, Fig. 11 extends nearly the top of *C*, Fig. 11 down to the point at the deepest part of the core but must be drawn out through the side of the box at *E*. As it is too wide at the point to pass through this slot, the arm is split lengthways and the top part is drawn through first and then the lower half is pulled through the same slot.

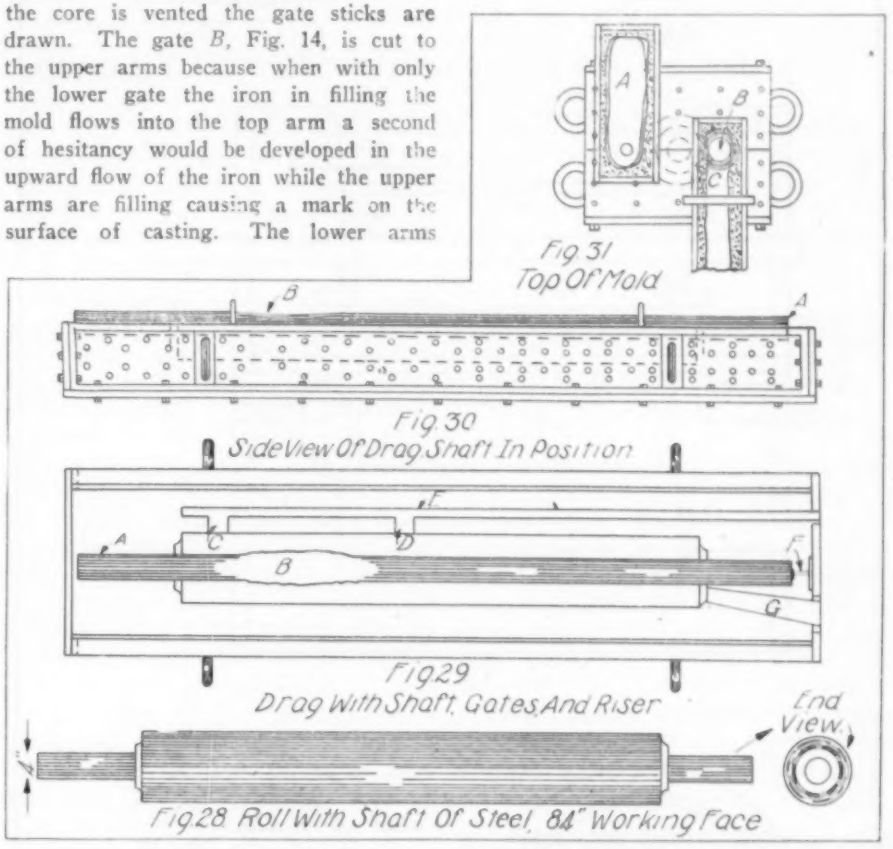


FIG. 28—ROLL WITH SHAFT OF STEEL, 84-INCH WORKING FACE FIG. 29—DRAG WITH SHAFT GATES AND RISER FIG. 30—SIDE VIEW OF DRAG FIG. 31—TOP OF MOLD

Placing the Cores

The corebox *X*, Fig. 11 is unbolted and removed leaving the round core sitting in the bottom of the corebox which is really the dryer. The shaft is grasped with a pair of tongs and the core is placed on the oven carriage. Fig. 15 shows the corebox for making the core to be placed on top of the core, Fig. 11, to form the core shown in Fig. 6. This core, it may be noted, slips down on the shaft and is pasted to the portion shown in Fig. 11. When the core, indicated in Fig. 11, is taken from the oven the bolts at *B*, holding the parts *A*, together are loosened, the core is hoisted out of the dryer, and the hub, *C*, is removed.

The core, *X*, Fig. 2, made in corebox, Fig. 16, is then pasted on the print *H*, Fig. 11.

Fig. 17 indicates the core *C*, Fig. 11. Fig. 18 is the top of the core in chill Fig. 2: Fig 19 the top of mold shown in Fig. 8.

A side view of the pattern of a roll having a 72-inch working face is shown in Fig. 20 and an end view in Fig. 21. The corebox for making the three sections of core for coring the roll is shown in Fig. 22. Fig. 23 is an end view of the corebox showing removable inside ends, *A*. These ends also are shown at *A*, Fig. 22, and are used for making the middle stays in roll, shown at *X*, Fig. 25.

The roll is cast on its side in two-part flask and is a plain job in molding. The principal considerations are the core and securing a sound roll. A shaft is shown extending through the center the whole length of the roll extending out at the one end 12 inches, and 9 inches at the other. This must be

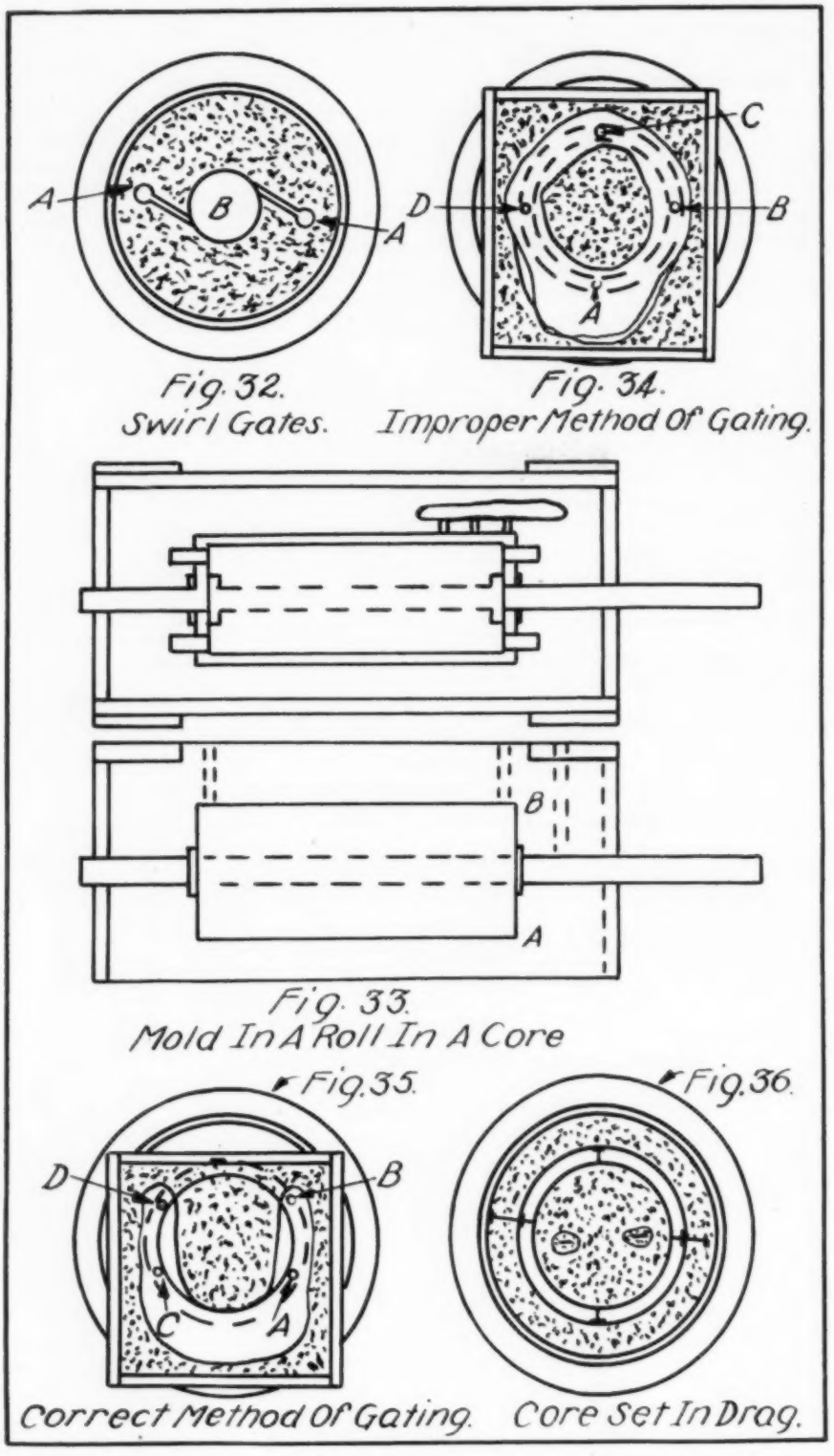


FIG. 32—SWIRL GATES FIG. 33—MOLDING A ROLL IN A CORE FIG. 34—IMPROPER METHOD OF GATING FIG. 35—CORRECT METHOD OF GATING FIG. 36—CORE SET IN A DRAG

in the center of casting. The half pattern is laid on the mold with the drag flasks placed around it. Pieces of board notched to fit the prints on the pattern which are to receive the shaft are nailed firmly in the drag extending across the prints shown at *A*, Fig. 24 and 25.

After the drag is rolled over, the cope part of the pattern is placed and the cope flask put on the drag, pieces of board are nailed across the cope forming a bar notched out as the ones in the drag and resting on the print of the pattern as at *B*, Fig. 24, but the two bars are left a little apart where not on pattern. Thus the core, *D*, Fig. 24 is held firmly between the bars, *B*, and *A*, insuring the shaft being located in the center of the mold and the core, *C*, Fig. 24 being placed so that an even thickness of metal is obtained around it. Fig. 25 shows the core set in the mold and mold gated at *B*, so the iron will not flow on the shaft. Fig. 26 is a view of the top of the mold showing pouring basins and flowoffs. Fig. 24 shows one end of the mold raised on a sand bed.

When molds of this kind are set level and poured, the iron filling the mold and rising on both sides of the core will sometimes pocket gas forming shelly spots where the two streams meet on top of the core. By raising one end of the mold the lower end fills first, and the iron as it rises drives any gas before it. Overflow metal is carried out by the riser *E*, Fig. 24. Extra venting with a small vent wire over the top of the roll where the flow of iron meets, will also assist in freeing the mold of gas. When the first of middle section of the core is made the pieces *AA*, Fig. 22, are kept in the box but are removed when the two end cores are made. As the three pieces of core are to be placed on the shaft and wired, pieces of leather are put in the box to form grooves to receive the wire. The core is shown as a whole at *C*, Fig. 24. As one core is butted against another, there is opportunity for a leakage of gas as it escapes from one core to another. To prevent this a piece of gaspipe, *A*, Fig. 27, smaller in diameter than the holes in the ends of the roll is used in each section in order that when the core is pasted these pieces can be arranged to carry away the gas. If these pipes are wound with rags soaked in core blacking good results are obtained.

Level the Cores

When the cores are taken from the oven the lower three half sections are placed in line on a level board and the shaft is laid in them. The pieces of gas pipe referred to, *A*, Fig. 27, are placed and pasted in. Thus a continuous vent channel is established through the entire length of the core. When the core is removed these pieces of pipe easily slip through the holes, *C*, Fig. 25 in the ends of the roll, if care is taken when selecting them. The shaft is set to measurement and the top halves are pasted on, slurried and wired. The wires are covered to prevent the iron from burning to them.

Contraction of the roll or *shrinkage* as foundrymen call it, is an important factor and few foundrymen have escaped paying the penalty its consideration exacts. In rolls of this kind it is better to arrange, with pins or keys, that the drive end shall be positive and allow the other end to slide or move on the shaft. This may be accomplished by applying a

thin coat of core blacking to the shaft on the end that is not to be positive. The movement of the end that was not positive amounted to 7/16 inch, thus showing the importance of considering shrinkage or contraction.

The gate should be arranged in a manner to avoid flowing iron directly against the shaft, as the tendency of iron flowing against a moderate sized shaft is to heat it to such a degree as to crystalize and weaken it.

The roll shown, Fig. 28, is one of a set of rolls used in conveyor tables of steel ingot rolling mills. A general average size would probably be 14 inches diameter by 72 inches working face. The sketch of the casting will answer for the pattern as the two would be alike. Even though this roll with the shaft in it is carefully molded, it is apt to be unsound if poured in a horizontal position. whereas when poured on end using a small quantity of overflow iron, the roll will usually be clean and sound.

Shaft Is Flattened

Fig. 30 shows the drag molded with the shaft, *A*, lying in it in the prints. *B* indicates where the shaft is flattened to make it positive in the casting. Fig. 29, *C*, *D*, and *E*, show the manner of gating. The shaft is held down with the chaplet at *F*, Fig. 29. The riser, or flowoff is shown at *G*, Fig. 29. The average shaft, *A*, is 4½ inches diameter and it may be easily seen that with so large a shaft the iron would cool too quickly if the mold was poured from a single gate at the bottom. Hence the gate shown at *D*, Fig. 29, in addition to the gate *C*, is used to carry the iron into mold from runner *E*.

Fig. 31 is a view of the top of mold showing the pouring basin, *A*, riser, *B*, and flowoff, *C*. The settling or shrinkage of the metal in the mold after pouring is small as the large steel shaft causes it to set quickly; hence but little pumping is required.

In the foregoing example it may be noted there is but one down gate. But it is found that a long roll of small diameter such as is used for rolling boiler plate, if cast with a single gate down, is apt to come out of the mold crooked as the down gate keeps it hotter on the side towards the gate. When a down gate is used on opposite sides, the roll comes straight.

A riser above the center of the roll is a large asset to help obtain a clean casting. As the iron rises in the mold the dirt comes straight up to the riser, but as the iron reaches the neck and rushes into the riser it has a tendency to push the dirt to one side and leave it near the upper shoulder of the roll. This makes it necessary to keep the dirt as near the center of the upper surface of the iron as it rises in the mold. The manner of gating to obtain a whirling motion to the iron in the mold to throw the dirt toward the center of the roll is shown at *A*, Fig. 32.

At times one may be called upon to make a small roll for which no flask is at hand to make it in. Fig. 33 shows a mold made in a core. A rough box of the size desired is made with 1-inch boards and the lower half of the roll is rammed up in it as in a drag, and a parting is made. Pieces of wood, known in foundry parlance as loose pins, are bedded in this part. These pins are about 3½ inches long, tapered from the center toward both ends with a diameter of 1 inch at the center. The second box forming the cope is placed on top. The gaggers instead of leaning against the sides of cope are placed with the upright arm next to the pattern. Both parts are also well rodded.

Fig. 34 shows a method of gating a sleeve or cored roll 12 to 16 inches in diameter and 6 feet or more in length, when no head is used. Often with this method of gating the casting on cooling is found crooked when gaged with a straight edge. One gate is shown at *A*, directly in the front of the pouring basin. This gate gets the first iron and will take it faster than either gates *B*, *C*, or *D*. Thus this side of the sleeve will be hotter than the opposite side and the casting will cool unevenly, one side drawing the other.

Fig. 35 shows gates *A*, and *B* arranged on one side and *C* and *D* on the opposite side. While gates *A* and *C* will take first iron as they are nearer the center of the sides, the iron on both sides of the roll will be nearer alike in temperature, and when the casting cools it will be straight.

Fig. 36 shows the core for a roll to be cast in an upright position, set in the drag. As no top print is used the core is held in the center by chaplets and the casting is molded longer than called for in order to have a shrink head and dirt catcher which is cut off.

Develops New Molding Machine Lines

The Pneulec Machine Co. Ltd., Roebuck Lane, Smethwick, near Birmingham, England, manufacturer of the combined electric and pneumatic jar ramming machines described in THE FOUNDRY, Dec. 1, 1920, is considerably increasing the scope of its operations. A roll-over core machine with an unusually deep pattern draw has been developed. This machine will take flasks up to 24 x 30 inches with up to 18 inches draw. A line of plain hand-ramming pattern-drawing machines equipped with adjustable features also has been developed, together with a rock-over jar-ramming machine which employs the combined pneumatic electric principle. The Pneulec company also is manufacturing core oils especially designed for use with silica sand. These core oils are intended to effect savings in the use of core dryers in connection with automobile cylinder work and for other intricate castings. The new oils are said to give the cores sufficient strength to make elaborate dryers unnecessary, at the same time permitting the use of a pure silica sand core.

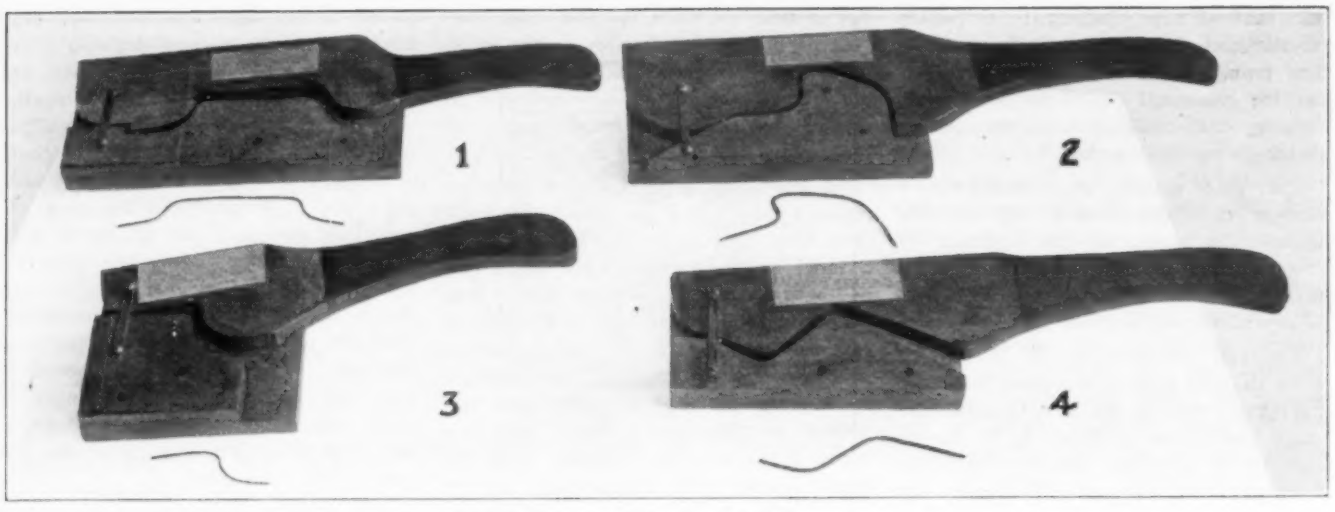
The Pneulec company is also manufacturing shelf type core ovens of various sizes. These core ovens have double insulated walls and other features designed to reduce fuel consumption. The average gas consumption for an oven 6 x 6 x 3 feet is said to be 180 cubic feet per hour, maintaining a temperature of 450 degrees Fahr.

Move I. B. F. Office

The Institution of British Foundrymen has moved its general offices in London from Bessemer House, Adelphi, to 38 Victoria Street, London, S.W.1, where more commodious quarters have been secured. The new offices are in the heart of the London engineering district. They will be especially fitted up for the convenience of the members of the institution and will remain in charge of W. G. Hollinworth, general secretary.

Foreign Segments Barred

No material manufactured abroad will be used in the construction of the vehicular tunnel which is to connect the island of Manhattan with Jersey City. A resolution barring foreign made material from the construction of the tunnel was adopted by the New York and New Jersey Vehicular Tunnel commission. The action was taken as a result of a suggestion by Chief Engineer Clifford M. Holland, which grew out of a letter from Booth & Flinn, Ltd. The latter firm of contractors wanted to know whether the commission would approve a contract based on the cost of cast-iron segments made abroad. In making its decision, the commission held that the materials for the tunnel should be made in this country, since foreign manufacture might result in delays, and differences of opinion as to quality might result in legal and other complications.



The Construction of the Wooden Dies is Simple

Core Wires Bent in Plain Wooden Dies

BY JOHN GRENNER

WIRE cutting and bending machinery is considered part of the regular equipment in foundries where large quantities of intricate cores are produced daily. The wires automatically are cut to a definite length and bent on suitable dies to the required shape. This method stands for economy of operation in two directions. It means that none of the wire is wasted and it also means that the coremaker will lose no time fitting the pieces in his corebox. The amount of core wire handled in some of the smaller foundries probably would not warrant the installation of expensive machinery, but the devices shown in the accompanying illustrations, developed in the foundry department of the University of Michigan, Ann Arbor, Mich., might be adopted profitably. While the dies shown in the illustrations have been provided for forming the wires used in a set of cores for a 2-cylinder gasoline engine, still the idea readily may be adapted and applied in any coreroom where bent wires are employed.

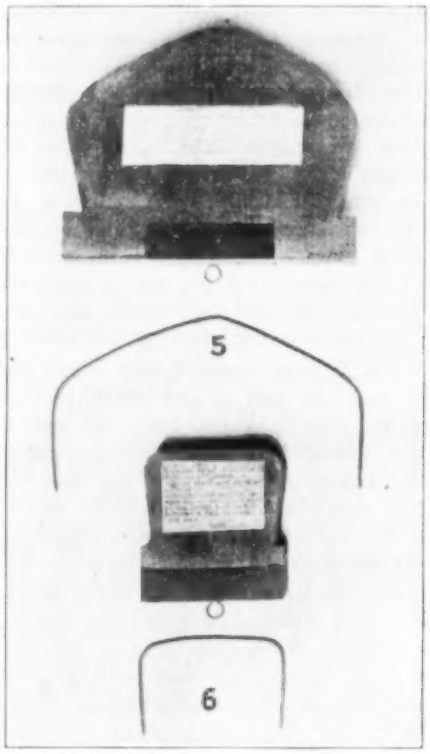
Before the dies were made, the wires were prepared according to the instructions on the card shown in Fig. 10. The method was not satisfactory, inasmuch as the students had to depend too much on guesswork and frequently a considerable amount of manipulation was necessary on the coremaker's part before the wires would lie properly in his box. This instruction card has been superseded by a list of individual instructions pasted on each die. For instance Fig. 6 reads:

1-22-C 81-W 1

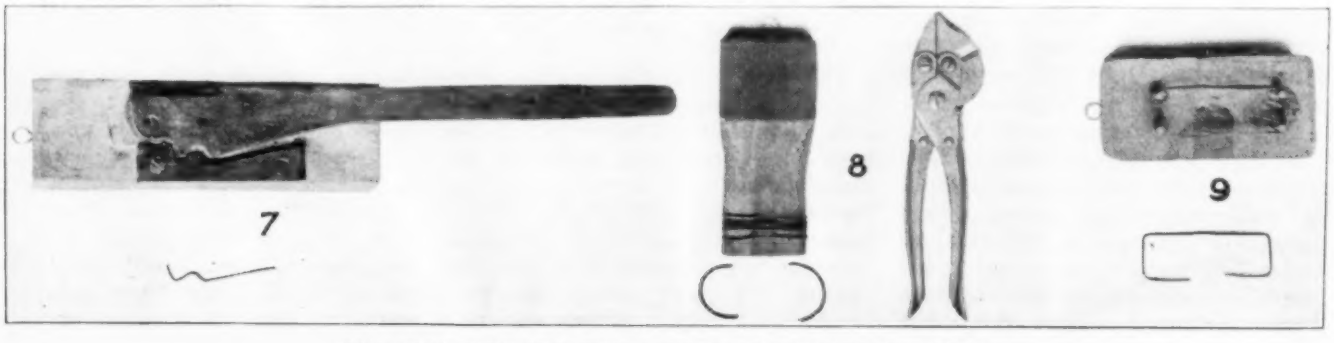
1. Obtain 33 feet of 12 gage wire from materials asst. .05
2. Cut to 15½-inch lengths
3. Clamp black part of form in vise
4. Beginning at one end bend wire around form. Place in box 1-22 C W 2
5. Repeat 4 until 25 wires are bent .15

Total .20 hrs.

A considerable amount of time is saved in actual bending the wires, but the greatest benefit from the method is felt by the man who makes the cores. The wires fit in the box without any extra work on his part. Some 10, 12 and 16 gage wires were em-



A LIST GIVING SPECIFIC INSTRUCTIONS ON HOW TO USE IT IS PASTED ON EACH DIE



DIES FOR BENDING WIRES USED IN MANIFOLD CORES

C2 1-12

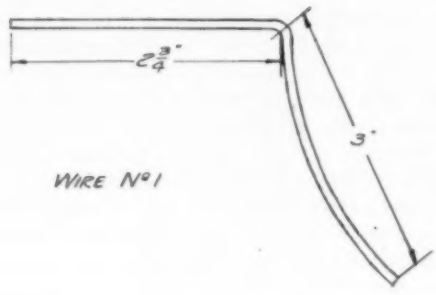
INSTRUCTION CARD
SHOP LABORATORIES
FOUNDRY DEPARTMENT

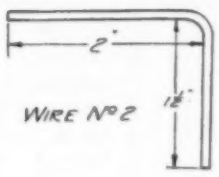
FLOOR BENCH *CORE* MACHINE STATION

PART *CYLINDER-RIGHT & LEFT*
ARTICLE *GAS ENGINE-A* PATT NO. *1-12*

STANDARD FLASK NO.
SPECIAL FLASK NO.
CORE BOX NO. CORE PLATE NO
SAND MIXTURE NO.
WIRE, SIZE *12 GA* RODS, SIZE
NO. LOOSE PCS. NO. CORES

TOOL KIT NO.
RAMMER
FACING MXT. NO.
TACKLE
PLIERS
RULE





ITEM	OPERATION ROUTINE	STANDARD TIME
	Note:- Wires for six cores.	
1.	Obtain pliers from tool room	0.02
2.	From stock room get 6½ feet of wire No. 12. Take to core bench	0.02
3.	Cut into 6 pieces 5¾" long and 12 pieces 3½" long	0.01
4.	Bend the 5¾" pieces as shown for wire No. 1	0.02
5.	Bend the 3½" pieces as shown for wire No. 2	0.02
6.	Place in core box C 3 1-12	0.01
7.	Return pliers Pl.26.6 to tool room	0.01
	TOTAL STANDARD TIME	0.11

FIG. 10—INSTRUCTION CARD WHICH HAS BEEN SUPERSEDED BY THE DIES SHOWN IN THE PRECEDING ILLUSTRATIONS

ployed in the examples shown here.

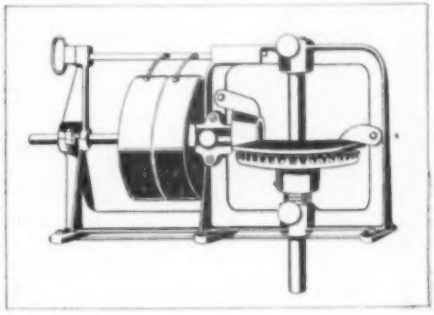
Difficulty was experienced in bending wire No. 1 with a pair of pliers. It now is bent without any difficulty in the die shown in Fig. 3 and as already stated, after it once has been bent no further adjustment is necessary. The dies for bending the wires used in reinforcing the intake and exhaust port cores, which form integral parts of the barrel core, are shown in Figs. 2 and 4. One of the bent wires in the jacket core is shown in Fig. 3. The dies employed for bending the wires used in the intake and exhaust gas manifold cores are shown in Figs. 5 and 7. The wires used in the water manifold cores are bent on the dies illustrated in Figs. 6, 8 and 9.

In Figs. 1, 2, 3, 4 and 6 the wires are bent to shape by placing a wire cut to length between the two parts and then closing the die. In Figs. 5 and 6, wires are bent around the dies, or forms. The wire is wrapped around the form in Figs. 8 and 9 and cut after it is bent. In shaping the different dies with the exception of No. 9 provision was made for the spring in the wire. In the case of No. 9 is was not necessary. With the exception of No. 7, made of iron, all the dies were made of hard wood reinforced with iron inserts where the wear was most severe. Dies of this character easily may be made on the band saw and as far as wear is concerned, it is stated that the dies shown in the illustrations apparently are as serviceable and accurate as when they first were tried out over a year ago.

Making a Frame Pattern

By John J. Murphy

It is no uncommon sight in any jobbing foundry to find wooden patterns that have long outlived their usefulness, and only are fit to be thrown in the cupola. These shops usually are equipped with a nonferrous melting installation of some kind and it is possible at comparatively little cost to transform some of the wooden wrecks into serviceable aluminum patterns. The frame for the device shown in the accompanying illustration is an interesting example of this. It was in such a condition that the owner was forced to pay a



TWO HALF PATTERNS MADE OF ALUMINUM FACILITATED MOLDING THE FRAME

premium to any foundry undertaking to make castings from it.

The pattern 4 feet long by 2 feet 10 inches wide with three foundation lugs 10 x 4 inches, was made in one piece and, as may be noted by referring to the illustration, was an awkward shaped pattern from which to make a mold. The pattern was symmetrical in that the journals, ribs and lugs were the same on one side as on the other. I made two half patterns, that is, one right and one left hand, which can be mounted on individual plates and rammed on a machine, or which may be fitted together with pins and dowels and made in the ordinary manner in a 2-part flask.

The pattern first was rammed in a drag in such a manner that the joint of the flask came in line with a center line on the pattern. An accurate flat parting was made along the line and then the pattern was drawn out of the sand and the mold covered wth a flat cope. A second mold was made in the same manner with the exception that the opposite, or cope side of the pattern, was made in the drag. The molds were made in French sand with drawbacks to compensate for contraction.

The Yale & Towne Mfg. Co., Stamford, Conn., plans to start a branch manufacturing establishment in the neighborhood of Pottsdam, Germany about March 1.

The latest census gives the number of automobiles registered in France as 236,725. On this basis, there is one automobile for every 205 persons.

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Research Methods Must Go Deeper

UNLESS a test reveals a condition which can be modified it is useless as a routine control method in manufacturing. Furthermore, the ease with which the test can be made is also a regulating factor. Thus an analysis of pig iron for the elements commonly found in it in appreciable quantities enables the metallurgist to mix the iron in such proportions that the metal from the cupola will have the composition desired, and an analysis of the casting will indicate whether the iron has been charged as ordered. However, a test for titanium and other elements which are sometimes found in cast iron in extremely small amounts is too complicated for routine work and would not give any indications which would permit the chemist to modify the mixture. On the other hand, such a test might be essential to the metallurgist making a research.

This indicates the vast difference between tests for routine control and those for investigational work. In the former, the test must be simple; in the latter it may be of the most complicated nature. In fact, the one cause for limited results in foundry research work is the lack of thorough investigation. Superficial methods in this line of endeavor bring little reward and in some cases lead to false conclusions which discredit research with many practical foundrymen.

Microscopic study of steel has indicated many laws by which steel may be controlled in the tempering operation, as well as showing the effects of different methods of pouring and rolling. In the cast-iron field metallography has not made as much impress as it has in the steel industry. A few metallurgists have developed the microscopic study of malleable iron until the annealing operation is becoming better understood, but little of practical value for the gray-iron foundryman has been obtained through microscopic investigation. The foundry has published from time to time, articles on the microstructure of gray iron. These articles give an idea of what might be done from the further investigation of this product under the microscope. While micrographs have been made showing sulphur spots, no method has been found to enlighten the investigator in regard to the condition in which sulphur exists in the iron; that is, whether it is in more than one form or not, the claim being made that *residual* sulphur affects the iron differently from that picked up in the melting operation. The condition of carbon also offers an important field for investigation. In steel, the state in which the carbon exists effects a marked influence and has been studied under the microscope. Microscopic investigation of carbon in gray iron has been confined largely to examining the shape and size of the graphite particles, but little has been indicated regarding the effects producing the different states of the graphite which was not already known. It would appear that research must go deeper and study the graphite formation at higher magnifications. Already investigations have shown the complexity of the graphite grain of which graphite is only a part. Possibly when the nature of the graphite particle is understood, a method of controlling it to give higher physical properties to the gray iron may be evolved.

Trade Outlook in the Foundry Industry

IMPROVEMENT in castings production is so slow as to be almost imperceptible, but a betterment is noted, which is not confined to single groups nor classes of castings. Gray-iron jobbing shops which, in the main, have been long suffering and were among the first to feel the full weight of the depression, note a slight pickup in orders. Inquiries which have long been dormant are reviving. This is particularly true in the eastern and New England states. Textile machinery foundries also are favored by increasing business, keeping pace with improvement in the supporting lines of manufacture, and automobile castings production is increasing.

Cast Pipe Active

Prospects indicate that with materialization of tonnage in sight the cast iron pipe industry will experience a demand unprecedented in the past five years. An inquiry for 50 miles of 6-inch and larger sizes in the Chicago district, coupled with an increasing demand for water mains in the East and also from the west coast gives indication of continued improvement. Further, gas main extensions, which have lagged for the past few years are projected for the coming summer. Improved demand for soil pipe and fittings is reported both by southern and eastern foundries. Stove foundries through the central states and particularly in the region surrounding St. Louis are hopeful of a return of the active operation which characterized last fall. Although some had set April 1 as the earliest possible date when they might resume activity, many now expect to reopen their plants within a few weeks. Radiator and furnace shops still are working on a satisfactory schedule with little apparent diminishing in the requirements.

Prices of Raw Material for Foundry Use

CORRECTED TO FEB. 9

Iron		Scrap	
No. 2 Foundry, Valley	$19.00	Heavy melting steel, valley	$14.00 to 14.25
No. 2 Southern, Birmingham	15.00 to 15.50	Heavy melting steel, Pitts.	13.75 to 14.25
No. 2 Foundry, Chicago	18.50 to 19.00	Heavy melting steel, Chicago	11.00 to 11.50
No. 2 Foundry, Philadelphia	20.85 to 21.25	Stove plate, Chicago	14.00 to 14.50
No. 2 Foundry, Buffalo	19.00 to 19.50	No. 1 cast, Chicago	14.50 to 15.00
Basic, Valley	17.75	No. 1 cast, Philadelphia	16.50 to 17.50
Basic, Buffalo	19.00 to 19.50	No. 1 cast, Birmingham	16.00 to 16.50
Malleable, Chicago	18.50 to 19.00	No. 1 cast, Buffalo	16.00 to 17.00
Malleable, Buffalo	19.00 to 19.50	Car wheels, iron, Pittsburgh	14.50 to 15.00
Coke		Car wheels, iron, Chicago	14.50 to 15.00
Connellsville foundry, coke	$3.50 to 4.25	Railroad malleable, Chicago	12.25 to 12.75
Wise county foundry, coke	5.50 to 5.75	Agricultural mal., Chicago	12.25 to 12.75
		Railroad malleable, Buffalo	13.00 to 14.00

Plumbing Shops Hopeful

Every indication points to a prosperous season for the plumbing goods foundries, as well as for the manufacturer of heating sundries. Figures recently compiled by the National Trade Extension bureau of the plumbing and heating industry plainly indicate the market which exists for the products of these industries. It is shown that over eight million passenger automobiles are in use, while only about five million homes in the country are provided with bath rooms and some three million possess modern heating plants. Further, the past few years have seen a compounding of house and apartment shortages while industrial and in some cases commercial construction has exceeded the immediate need. These facts, coupled with the continued activity of foundries serving the industries mentioned seem to support this assumption. The passing of the automobile show season has witnessed some improvement in the automotive castings lines. This is indicated more strongly by purchases of materials by foundries than by a marked increase in the orders although some few companies, notably those in Michigan are ordering automobile castings in greater quantities in anticipation of improvement in sales through the spring.

Gain Slight in Pig Iron

According to statistics compiled by *The Iron Trade Review*, January showed only a slight improvement in the production of pig iron. The total for January was 1,645,804 gross tons as compared to 1,642,775 tons for December. The January figure is the highest noted in the past 11 months, being second only to the total for February, 1921. The total production of merchant pig iron for January was 362,008 tons, which shows a loss of 9992 tons when compared with the December total of 372,000 tons. The January output was at the rate of 11,677 tons per day, or a loss of 323 tons per day from the 12,000 ton daily average for December. Blast furnaces in operation totaled 127 on the last day of January as compared with 123 on the last day of the preceding month. During the month three merchant iron stacks were blown out and none blown in, so that the manufacturing capacity for this class of iron was slightly curtailed. A bright spot in the general situation is evident in the increase in purchases of railway equipment. Steady advance is noted in the number of cars ordered from week to week, culminating in the early weeks of February in an order for 6800 cars from the Burlington, marking the largest transaction of its kind since government operation ceased. Inquiries also are increasing and sentiment is crystalizing which probably will result in more and larger railway purchases soon. The idle car figures have been dropping, the report of the American Railway association for the week of Jan. 15 to 23 showing a daily average surplus of only 396,192 cars as compared to 439,982 cars for the preceding week. Malleable foundry operations showed but slight improvement in December, and January, probably will be but little better.

Nonferrous Spotted

Nonferrous foundry operations share in general with allied foundry lines. Demand for automotive castings is light. Plumbing brass goods are active. Prices on nonferrous castings based on New York quotations in the *Daily Metal Trade* of Feb. 9 follow: Casting copper, 12.50c to 12.75c; electrolytic copper, 13.00c to 13.25c; Straits tin, 31.50c; antimony, 4.40c; lead, 4.70c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c and open market, 14.00c to 14.50c. The average monthly prices for January follow:

(New York Quotations)

Casting Copper	Electro. Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.98	13.81	4.72	32.05	4.46	17.64	4.72

Comings and Goings of Foundrymen

LOUIS A. WAY, assistant to the president in charge of sales, was elected second vice president at the recent annual meeting of the Duquesne Steel Foundry Co. Mr. Way will continue in charge of the sales department. Other officers were re-elected, as follows: President, Donald C. Bakewell; first vice president, W. E. Hoblitzelle; secretary. Benjamin P. Bakewell; treasurer, Edwin S. Eggers.

Charles M. Alleman, formerly foundry foreman for W. H. Jahns, Los Angeles, Cal. has been promoted to the position of superintendent.

Andrew Heilman, formerly foundry foreman for the Meech Foundry Co. Cleveland, is now secretary and treasurer of the company.

H. M. Jacoby of H. M. Jacoby Co., has been elected a director of Abendroth Bros., Port Chester, N. Y., manufacturer of soil pipe and fittings, gas ranges and heaters.

Frank H. Marsh, formerly superintendent for the Columbiana Foundry Co., McKeesport, Pa. has taken charge of the foundry department of the Pittsburgh Engineering Co., Jeanette, Pa.

Mathew Wagner, is in charge of the foundry department for the Rich Steel Products Co., Vernon, Cal. Mr. Wagner formerly was foreman for the Los Angeles Valve & Fittings Co., Los Angeles, Cal.

A. T. Drysdale, who for the past two and a half years has been superintendent of the Bessemer, Ala. plant of the Central Foundry Co., has been transferred to the Dundalk plant of the same company, Dundalk, Md., where he will occupy a similar position.

John G. Maroney, formerly foundry superintendent for W. H. Jahns, Los Angeles, Cal. is now vice president and foundry superintendent for the P. R. & V. Products Co., Santa Ana., Cal., manufacturer of piston rings, valves and other automobile parts.

Eben Hill has resigned as director and president of the Norwalk Iron Works Co., South Norwalk, Conn., which was founded by his father, Eben Hill, over 50 years ago, and this is the first time it has been out of the direct management of the Hill family.

Clarence E. Killinger, former secretary and treasurer of the Wilson Foundry & Machine Co., Pontiac, has been selected to be general manager of the Willys-Morrow Co. with plants at Elmira, N. Y., producing transmissions and screw machines for the Willys-Overland Co., Toledo, O. Mr. Killinger has been acting as an assistant to C. B. Wilson, vice president and general manager of Willys-Overland Co.

R. T. Crane Jr., president of the Crane Co., Chicago, has been elected president of the Crane-Enamelware Co., Chattanooga, Tenn., which has been formed through the merger of the Mutual Enamelware Co. and the Cahill Iron Works. He succeeds Frank H. Caldwell, president of both the Mutual and the Cahill companies. J. T. Berryman, Chicago, has been elected first vice president of the new company, J. J. Maloney second vice president and H. W. Powell secretary.

L. O. Smith has been appointed sales manager of the Midland Motor Cylinder Co. Ltd., Smethwick, near Birmingham, England, this company being one of the leading manufacturers of automobile cylinders, pistons, fly wheels, etc., in Great Britain. Mr. Smith will also be personal assistant to A. E. Pearce, joint managing director of the Midland company. Mr. Smith has been for many years associated with British engineering enterprises including Alfred Herbert, Ltd., machine tool manufacturers, Coventry; Dennis Bros., Ltd., and S. Smith & Sons, Ltd. The Midland Motor Cylinder Co., Ltd., also has appointed M. V. Thompson, 4 Jane street, Blythswood Square, Glasgow, to be its representative in Scotland. Mr. Thompson will also represent the Birmingham Aluminum Castings Co., Ltd., Birmingham, this concern being affiliated with the Midland Motor Cylinder Co.

Bureau of Mines Reports Investigations

Work of the federal bureau of mines in the year ended last June 30, it has been announced, included investigations of the low grade iron ores of the Birmingham district, the manganiferous iron ores of the Lake Superior district and the iron and steel situation in the Pacific coast states, H. Foster Bain, director of the bureau, states in his annual report to Secretary of the Interior Fall.

An investigation of scrap losses in aluminum alloy foundry practice showed that the annual losses in the United States amount to $1,200,000 and that universal adoption of methods recommended by the bureau would halve this loss. Melting losses in this industry, which are largely preventable, aggregate $3,000,000 annually. Properties and possibilities of molybdenum also were probed.

Plans have been formulated, says Director Bain, for an investigation of propesed methods for the electrothermic metallurgy of zinc with the view of increasing recovery of the metal and lowering production costs. Present production costs of zinc are so high as to endanger the position of zinc as a cheap metal, the report states.

In the past year the bureau has concluded a report on recent developments in electric brass melting. The bureau also has completed work on preparation and analysis of special alloy steels for the navy. At the southern experiment station of the bureau at Tuscaloosa, Ala., which was established in the year, a start was made on an investigation of the physical properties of coke. At the north central station at Minneapolis study of rock drill steels was continued on a larger scale. In the year ended June 30 the war minerals relief commission passed 1150 claims, making awards totaling $3,162,040 in 373 cases.

Addresses Foundrymen on Machine Application

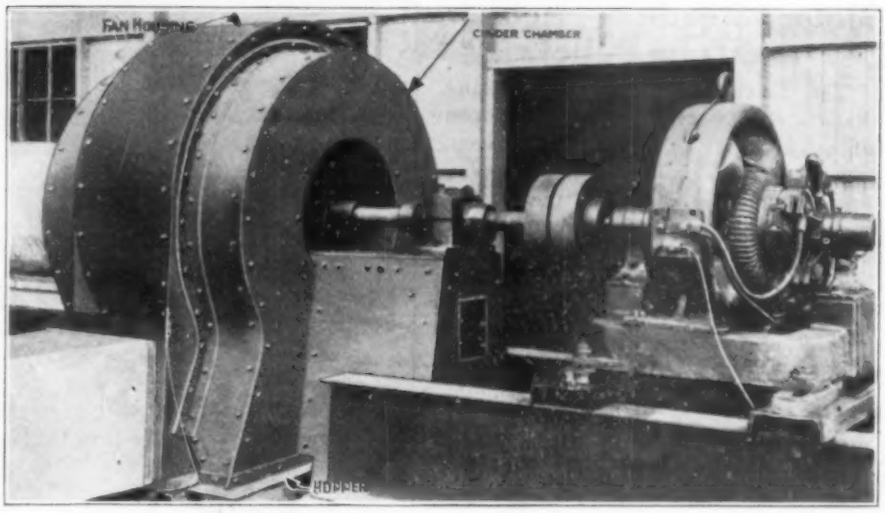
"The Application of Molding Machines to Miscellaneous Castings Production" was the subject of an illustrated talk by Edwin S. Carman, Cleveland, at the regular February meeting of the New England Foundrymen's association. The speaker is secretary and chief engineer of the Osborn Manufacturing Co.

Issues New Proceedings

The first issue of the *Proceedings of the American Welding Society* has made its appearance under the date line January, 1922. This publication is devoted to the affairs of the American Welding society and in addition publishes technical papers, items, abstracts and reports which comprise the literature of welding. The officers of the American Welding society include S. W. Miller, president; W. E. Symonds, treasurer, and M. M. Kelley, acting secretary. W. Spraragen, 33 W. Thirty-ninth street, New York, is editor of the proceedings.

Draft Fan Catches Cinders

An induced-draft fan which also acts as a cinder separator has been designed by the B. F. Sturtevant Co., Boston. Buckets which catch the cinders are provided at the inlet edge of the blades of the paddle wheel fan. The dust thus caught by the revolving wheel settles along inclined channels to a special dust chamber in the fan. These chambers lead to closed hoppers into which the dust settles and from which it can be periodically removed or, by the use of screw or other conveyor, it may be removed continuously. The accompanying illustration shows the cinder chamber at the left of the fan housing. The closed hopper may be noted at the base of the fan. These fans already have been installed in several power houses. At one plant the material separated resembled fine coke breeze and on analysis showed a heat value of approximately 9700 B.t.u.



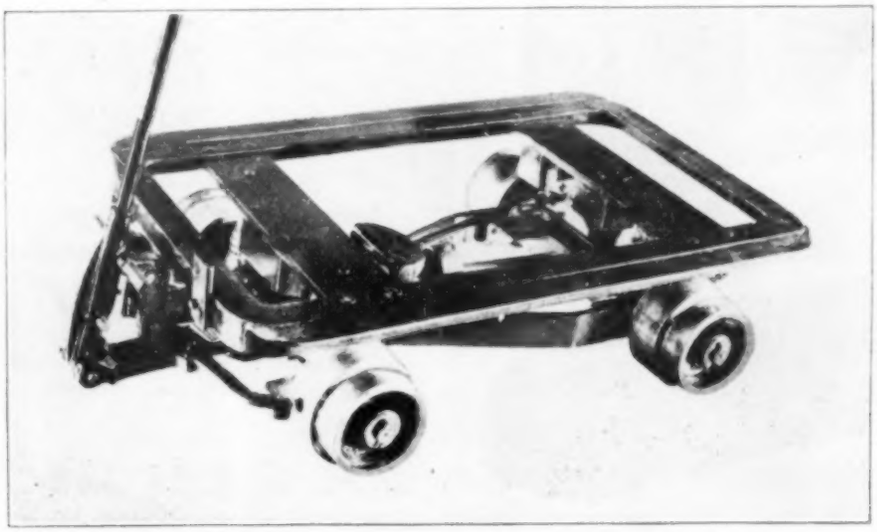
CINDERS CAUGHT ON THE FAN BLADE SETTLE ALONG INCLINED CHANNELS INTO DUST CHAMBERS FROM WHERE IT FALLS INTO CLOSED HOPPERS

Truck Can Be Used Either on Track or Floor

The heavy-duty, elevating-type truck shown in the accompanying illustration, made by the Plimpton Truck Co., Stamford, Conn., has been equipped with a set of special wheels by which it is claimed it can be employed with equal facility either on a regular narrow gage track or upon the floor. The wheels present two surfaces, like a one-step pulley. The outer or small face runs on the rail and the inner or large face takes the weight of the truck when it is necessary to drive it across a floor of any description. It is stated that it has been developed primarily as a charging truck for foundries, and it is the intention of the manufacturer to market these trucks in various sizes and capacities.

Other features of interest included in the construction of the truck include a radiused front end plate in the form of a combined step and thrust bracket, against which the operator may press the handle to force the load backward to any desired location. Loaded platforms are released by pressing the pedal. The handle automatically is retained in a vertical position when not in use so that it cannot drop down between floors on an elevator or elsewhere.

The platforms used in connection with the truck are equipped with metal legs substantially screwed to 3-inch skids. They have approximately a 2-inch clearance between skids, ⅝-inch underneath and average 10 inches wider than the truck. If necessary, the manufacturer is prepared to furnish live skids by substituting sets of ball-bearing casters for the metal feet.



EQUIPPED WITH SPECIAL SHAPED WHEELS THE TRUCK IS ADAPTED FOR BOTH TRACK AND FLOOR USE

Cast-Iron Storage Tank

A storage tank built up of ½-inch, cast-iron, radius plates, each 2 x 2 feet, held vertically between cast-iron *H*-sections, recently has been developed and placed on the market by the Conveyors Corporation of America, 326 West Madison Street, Chicago. The tank was not designed for holding liquids but for dry storage purposes. For instance, it may be used for holding ashes, coal, building materials and many kinds of foundry supplies including coke and sand. In fact it may be used for loose, bulky materials that ordinarily are stored in silos, tanks, hoppers or bins.

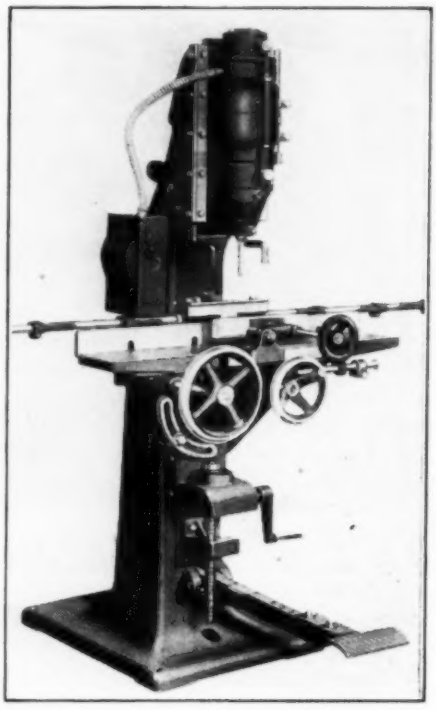
Among the advantages claimed for the cast-iron storage tank are its long life and low maintenance cost. It is stated that it resists corrosion, abrasion and rust, and it is easy to assemble and erect. The tank is cylindrical in shape and is erected on a 5-inch reinforced concrete slab, supported on a structural base or tower, built up of standard fabricated structural shapes. The tank may be built to any convenient height. It is covered with a cast-iron top and is provided with a ladder. All inside joints are sealed with a special cement mixture. Each tank is equipped with two undercut gates which allow maximum tonnage to be withdrawn. Since there are no corners on the inside of the tank these gates insure a clean discharge. A rolled steel angle at the base, together with steel rods resting on lugs running completely around the exterior prevent side thrust and eliminate the necessity of structural supports about the tank body.

The Columbus Foundry Co. Columbus, Ga., and the W. L. Lemly Foundry Co., Bessemer, Ala., have merged. The soil pipe plant of the Columbus firm will be moved to Bessemer.

Motor Requires Neither Shafts or Pulleys

The Oliver Machinery Co., Grand Rapids, Mich., recently has developed an original type of direct motor-driven, vertical-spindle, hollow-chisel mortiser, one of which is shown in the accompanying illustration. The motor runs at 3600 revolutions per minute and operates either on two or three phase 60-cycle current and forms an integral part of the mortising head or ram. One housing serves for both motor and motor head. The motor requires no bearing since the rotor of the motor is mounted directly on the spindle running in high grade ball bearings. It is connected to a safety first enclosed starting switch through a flexible conduit.

The machine is equipped with compound table having hand wheel rack and pinion feed and clamp for work and also the bushings, wrenches and other usual accessories. Among the advantages claimed for this machine are that it eliminates counter shaft, mule pulleys and belts, saves floor space, may be set up anywhere in the shop irrespective of the position of line shafting, it is self-contained and it is said the operating cost is low.

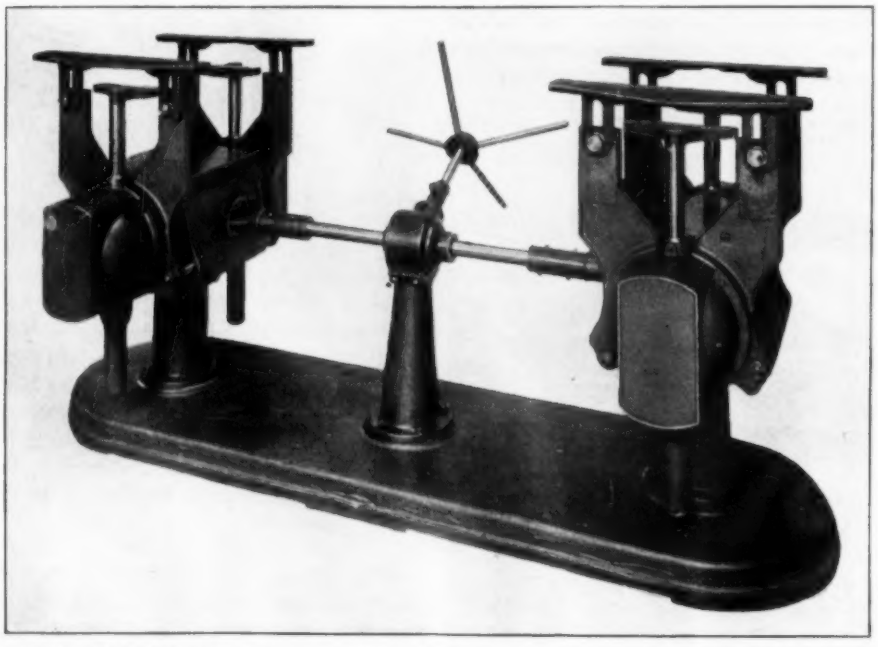


THE MOTOR FORMS AN INTEGRAL PART OF THE MORTISING HEAD OR RAM

Molding Machine Is Rigged for Long Flasks

For handling narrow flasks, with a comparatively deep pattern draw, the Adaptable Molding Machine Co., Birmingham, England, has developed the duplex equipment shown in the accompanying illustration. Two standard machines, with their supporting columns 48 inches apart, are mounted on a single heavy cast-iron bed plate. This makes it possible to handle flasks up to eight feet in length, and owing to the adjustable feature previously described in THE FOUNDRY, the draw-rails of the machines will fit any width of flask between 12 and 20 inches or 18 and 26 inches, depending on whether machines of the smaller or larger size are employed.

This rig was designed originally for molding platform-scale beams. The pattern-drawing stools of both machines are connected to the central shaft shown in the illustration. As also illustrated, this shaft is divided in the middle and fitted with bevel gears connected to the spider wheel shown in the background. By turning the spider wheel, the pattern-drawing stools of both machines work in unison, the whole operating as a single molding machine. The draw is 6 inches. If desired the central shaft may be disconnected and the machines turned 90 degrees on their bases. They may then be operated independently in the ordinary manner as two separate machines, and still be available for operation as a single unit when desired.



TWO MOLDING MACHINES WITH THEIR PATTERN DRAWING MECHANISM CONNECTED FOR OPERATION AS A UNIT

Obituary

John G. Nordeen, founder of the Nordeen Iron Foundry, Vancouver, B. C., died Jan. 28. He went to Vancouver from Kansas City 15 years ago and his small foundry developed into the present substantial plant on Grand avenue.

Colgate Hoyt, a director and member of the executive committee of the United States Cast Iron Pipe & Foundry Co., died recently at his home in Center Island, N. Y. He was 73 years old and was a native of Cleveland. He also was a director of the Canada Copper Co. and the Cuba Copper Co. At one time he was president of the Automobile Club of America.

James J. Allen, general manager, Monarch Engineering & Mfg. Co., Baltimore, died suddenly at his home in that city Jan. 23.

Postpone Opening Vehicular Tunnel Bids

The formal opening of bids on the New York-New Jersey vehicular tunnel, scheduled for Feb. 7, was postponed until Feb. 15 at the request of several of the contractors, only two firms being in position to submit bids Feb. 7.

Appointed Sales Agent

Ingersoll-Rand Co., 11 Broadway, New York, has been appointed general sales agent for the Ratbun Jones Engineering Co., Toledo, O., manufacturer of vertical, multi-cylinder type gas engines ranging from 100 to 1450 brake horsepower.

H. L. Carpenter Jr., formerly in charge of the Pittsburgh office of the Ajax Metal Co., Philadelphia, has been made special traveling representative in western Pennsylvania.

Foundry Equipment Sales Meager

Slight Activity in the Equipment Field Confined Mostly to Small Installations and Repair Orders—The Latter Principally from Foundries Doing Automobile Work

LITTLE new business has developed in the equipment field recently but considerable replacement orders have been given by foundries doing automobile work. Foreign activity is indicated in a report that the Marsuo Shipyard, Inasa, Nagasaki, Japan is contemplating the production of steel castings and is asking for information in regard to equipment. This firm now makes gray-iron, malleable and nonferrous castings. A New Zealand firm which has hand operated molding machines manufactured by the Berkshire Mfg. Co., Cleveland is contemplating changing them to operate with power. The W. W. Sly Mfg. Co. have been awarded the contract for a complete sand-blast equipment by the American Car & Foundry Co. This equipment, which is to be used at the Detroit plant of the Car & Foundry company, is designed for cleaning four freight cars at one time doing the work at the rate of four cars an hour. The Sterling Brass Co., Cleveland, plans to begin work in about a month on a new plant. It is expected to cost about $100,000, but contracts have not been let. Oil furnaces will be used.

Pittsburgh District Encouraged

PITTSBURGH district foundry equipment sellers are encouraged over the issuance of a number of inquiries since the first of the month. One of the largest inquiries comes from a large foundry interest in this district calling for tumbling barrels, turn tables, yard trucks and considerable other equipment. Recent sales include grinding stands to a Philadelphia foundry, molding machines to one large New Comerstown, O. interest, and several cranes and ladles to a nearby user. The local representative of the Whiting Corp. reports a few sales and an encouraging number of inquiries for its helical worm geared ladles although the sales are confined to the smaller sizes, 2-ton, etc. Several crane propositions from foundries and other users are before the trade and hoist inquiries are particularly numerous. The United Engineering & Foundry Co., Pittsburgh, recently closed on a 15-ton Shaw crane with 5-ton auxiliary, while the Elliott Co., Jeannette, Pa., founder and machinist, bought a 5-ton Cleveland crane. Another Jeannette consumer, the Northwestern Expanded Metal Co., purchased a conveying system with 80-foot centers from S. W. Hays Sons, and the National Radiator Co. still is negotiating for an 8-foot sand mixer. One or two core oven propositions are pending and since core ovens have recently been reduced 45 cents per square foot it is expected that core oven buying will be somewhat stimulated. The Charleroi Iron Works, Charleroi, Pa., recently entered the market for a keyseater.

Chicago Markets Dull

WHATEVER quickening of demand and buying may have been noted a few weeks ago in the equipment trade it has been dissipated recently. A large producer of foundry equipment has sold a few ladles and some other minor equipment, but has not found buyers for cupolas and other large appliances. A manufacturer of an important labor-saving foundry device has found it difficult to sell, even when he can demonstrate an actual money saving sufficient to pay for the equipment and give a profit in the first year. The Niagara Radiator & Boiler Co. is building a plant at Eighty-third and Woodlawn avenue, Chicago, in which the Industrial Furnace Builders, Inc., are installing a twin chamber malleable melting furnace, with a capacity of 10 tons to each chamber, fired with powdered coal handled by Grindle powdered fuel equipment. Engineers specializing in foundry work find little new business to interest them, and while the cost of building is considerably lower, confidence still lacks and prospective plants and additions are being held up. The plant of the Diversey Foundry Co., Chicago, was destroyed by fire Feb. 3, and the company is negotiating for the purchase of another plant in which to carry on its work.

Some Business in the East

SELLERS of equipment continue to report a slight but steady improvement in demand. As a matter of fact, in some instances they assert that trading has made a substantial improvement. It appears that no large orders are being placed, indicating a lack of new construction in the foundry field, but that orders are more numerous. This improvement is still in evidence, particularly in the New England district. While buying in connection with the proposed New York-New Jersey vehicular tunnel work has not as yet set in, it is expected to do so shortly.

Included in the few newer projects contemplated for the near future is a repair shop for the New York Central railroad at Lyons, N. Y., where a small foundry is to be erected. Among other projects is a two-story, 40 x 40-foot foundry, for the S. V. Reeves Stove & Foundry Co., Camden, N. J. The Floyd Wells Co., Royersford, Pa., will erect a two-story, 30 x 120-foot addition to its stove plant, and the Segal Metal Products Co., Stamford, Con., will build a two-story foundry to replace one recently damaged by fire.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

At the recent meeting of the stockholders of the Valley Foundry Co., East Hampton, Conn., the following officers were elected: President, George Ray, Hartford, Conn.; treasurer, John Dahlgren, and secretary, Reuben Ostergren.

Among the shipments of sheet galvanizing plants made recently by the Erie Foundry Co., Erie, Pa., is included one to the Empire Rolling Mill Co., Cleveland, and two to the River-

side works of the Otis Steel Co., also of Cleveland.

Capitalized at $20,000 to manufacture pumps and steam devices, the G. U. Ladd Co., Worcester, Mass., recently was inaugurated. George U. Ladd is president of the company and George D. Morse, secretary and treasurer.

Officers recently were elected by the stockholders of the W. & B. Douglas Co., Middletown, Conn., manufacturer of pumps, etc. They are: President, Dale D. Butler; vice president, W. B. Douglas; treasurer, George D. Hastings; secretary, Fred E. Gibbons and the directors in addition to the officers are Earl Butler, Frank Coles, Joseph Merriam, Joseph Porter, T. M. Russell and George W. True. The company recently increased the operating schedule of its foundry from four to five days a week.

Capitalized at $25,000 the General Die Casting Co., 2533 North Ashland avenue, Chicago, recently was incorporated to manufacture and deal in dies and die castings, by M. C. Luhr, J. G. Turner, D. C. Robson and others.

Plans are being prepared for the Standard Tank & Heater Co., Philadelphia, for the erection of a factory building in Camden, N. J. Horace M. Hakanson is architect.

The Keller Foundry Co., Knoxville, Tenn., is reported having plans prepared for the erection of two additions to its plant.

Washington offices of the Pressed Steel Car Co. and the Western Steel Car & Foundry Co. have been discontinued. L. O. Cameron, who represented these companies, has resigned, although he will maintain an office in the Munsey building to handle other accounts.

The Hatboro Foundry Co., Hatboro, Pa., has been reorganized with the following officers: President, W. W. Wilgus; secretary, Kenneth Farnsworth and assistant secretary and treasurer, Charles Schwab.

The Conemaugh Iron Works Co., a new corporation with offices at Latrobe, Pa., and works at Blairsville, Pa., has purchased the buildings of the Blairsville Iron Works. The new company will specialize in split ingot molds, stools and miscellaneous gray iron castings.

The Detroit Copper & Brass Rolling Mills, Detroit, recently elected the following directors at its annual meeting: A. H. Buhl, L. D. Buhl, C. B. Davis, F. J. Hecker, F H Hoffman, L. H. Jones and R. P. Joy. The following officers were also elected: President and general manager, L. H. Jones; vice presidents, R. P. Joy and A. H. Buhl and secretary-treasurer, A. J. Peoples. Alexander Henderson was appointed works manager.

The capital stock of the Etowah Foundry & Machine Co., Gadsden, Ala., recently was increased from $10,000 to $20,000.

Further electrification of the American Brass Co. plant at Bridgeport, Conn., is reported. Electric furnaces are being installed and electric motors will replace steam engines for furnishing power.

Frank D. Chase, Inc., Chicago, architect and engineer, is building a foundry at Cadillac, Mich., for R. J. Tector and associates.

The Atlas Foundry Co., Marion, Ind., has been incorporated with a capital stock of $10,000, by C. E. Swank, C. P. Osborn and O. V. Coon.

The American Brass & Foundry Co, Milan, Mich., is having plans prepared for the erection of an addition to its plant.

Another manufacturing plant has been secured for Adrian, Mich., through the sale of a portion of the plant of the Adrian Steel Castings Co. to the Anchor Concrete Machinery Co., of Rock Rapids, Iowa. It is understood the company plans to erect several additional buildings.

The Union Port Brass Foundry Co., New York, recently was incorporated with a capital stock of $30,000, by H. V. Beborfald, B. F. Vineburg and P. E. Uhr. The company is represented by Marken Bros, 26 Broadway.

The Hesse-Ersted Iron Works, Portland, Oreg., recently was incorporated with a capital stock of $150,000 to engage in a general foundry and machine shop business, by Fred Hesse, A. J. Ersted and several others.

The Gartland Danville Foundry Co., Danville, Ind., recently was incorporated to engage in a general foundry business with $10,000 capital stock by C. E. Swank, C. P. Osborn and O. V. Coon.

Recent large orders for machinery castings have resulted in the placing of the foundry of the Carhart Btos Foundry, Inc., 1620 North Salina street, Syracuse, on a full time operating basis.

Ground has been broken at Warren, O., for the erection of a plant for the Alloy Electric Steel Casting Co. The plant will be erected on a site of 21.6 acres which was donated by the Warren board of trade. The company will manufacture castings of every size from 1 pound up to 15 tons.

Articles of incorporation have been filed by the Perfect Pump & Machinery Co., Marshfield, Wis. The company is capitalized at $25,000 and was incorporated by Vernon Berg, Ben Grube and Hugh W. Goggin.

The Alliance Brass & Bronze Co., Alliance, O., recently increased its capital stock from $15,000 to $100,000.

The Ohio Alloys Co., Fostoria, O., which is backed by New York and Chicago interests, has bought the Louden glass plant of the General Electric Co., and will remodel it for the manufacture of metal alloys. It is expected the plant will be ready for production within a few weeks. H. J. Hayden is head of the company.

The Hart Mfg. Co., 2006 High avenue, Louisville, Ky., recently took out a permit to erect a foundry building at an estimated cost of $7000.

The Acme Brass & Machine Works, 1628 Oak street, Kansas City, Mo., is having plans prepared for the erection of a shop building, 25 x 115 feet.

Roscoe Ady, industrial commsisioner of the Ft. Worth, Tex., chamber of commerce, has announced that the Wichita Falls Foundry & Machine Co. will establish a plant in Ft. Worth. The company recently took out a permit to erect a factory building construction of which is to be undertaken immediately. J. V. C. T. Christensen is president of the company, which it is reported will employ at least 100 men.

Reorganization of the Aetna Engine Works of Menomonie, Wis., without change of ownership as the Forster Foundry Co., capitalized at $10,000 has been completed. Herman H. Forster, who founded the business as the Dunn County Iron Works in 1898, becomes president and general manager; Samuel H. Forster, who became a partner in 1912, is vice president, and George B. Forster, a member since 1916, is secretary and treasurer. The company manufactures stove castings, posts, sand screening machines, coal chutes, fire escapes, etc.

Plans have been completed by Frank D. Chase, Inc., 654 North Michigan avenue, Chicago, for the erection of a new foundry for the Bucyrus Co., South Milwaukee, Wis. The building will be of brick with steel sash, 60 x 275 feet. The Bucyrus company manufactures steam shovels, drag line excavators, dredges, locomotive cranes, etc. W. W. Coleman is president.

New Trade Publications

PIPE AND FITTINGS—The Lynchburg Foundry Co., Lynchburg, Va., is circulating a new edition of its cast iron pipe and fittings catalog. The booklet contains data and information bearing on the subject of cast iron pipe and fittings, and this is presented in a concise manner. The booklet is leather bound.

MILL AND FOUNDRY SUPPLIES—A large 56-page illustrated booklet has been published by George W. Kyle & Co., Inc., New York. Mill and foundry supplies are described and illustrated, as well as materials, chemicals and equipment for polishing and electro-plating plants. The information given concerning the various supplies is interesting and valuable, and complete specifications, etc., are given.

TRACTOR CRANE—The Industrial Works, Bay City, Mich., is circulating a catalog in which a crawling tractor crane of 20,000 pounds capacity is described and illustrated. This crane is said to be adapted to the needs of road contractors, lumber and coal dealers, gravel, sand and stone producers, foundries, railroad reclamation and storage yards and moderate-size manufacturing plants.

SAWS AND TOOLS—The Hunter Saw & Machine Co., Pittsburgh, has published an 88-page illustrated catalog in which a complete line of solid and inserted tooth metal cutting circular saw blades, inserted tooth setting device, serrating device for friction discs, slate saws, pipe cutters, circular knives, rotary shear blades, saw sharpening machines, pneumatic hammer rivet sets, chisel blanks and hardened steel specialties are described and illustrated.

POWER PRESSES—The Loshbough-Jordan Tool & Machine Co., Elkhart, Ind., is circulating a folder in which inclinable power presses are described and illustrated. These machines are built along simple and durable lines, embodying every modern convenience for accurate and speedy production, as well as safety. The presses are built in three types, plain flywheel, geared, or combination geared. Complete specifications are given.

ENGINES—The Mesta Machine Co., Pittsburgh, has published a 24-page illustrated booklet in which mill, blowing and power engines are described and illustrated. These engines are of the type patented by Johann Stumpf, Germany, the Mesta company having license to manufacture them in the United States and Canada. A full detailed description is given of the various engines, supplemented by illustrations and line drawings.

MOTOR-GENERATOR SETS—The Ideal Electric & Mfg. Co., Mansfield, O., has published an 8-page illustrated booklet in which motor-generator sets are described and illustrated. These generator-sets are applicable to a broad field, and according to the booklet, have been found unusually applicable and efficient for direct-current voltage transformation and for all applications where transformation is required from alternating current to direct current or from direct to alternating current. Complete infomation is given.

AIR COMPRESSORS—The Bury Compressor Co., Erie, Pa., is circulating a 20-page illustrated booklet in which its line of air compressors is described and illustrated. These compressors are adapted for mounting a synchronous motor on the shaft between the bearings and the two main frames. These compressors are built in sizes ranging from 300 cubic feet to 10,000 cubic feet capacity. Some of the features of design as pointed out in the booklet are: Direct connected synchronous motor mounted on shaft, round sectional main bearings, sectional intercooler, same ratio of compression at all loads, no undue heat at any load and patented pyramid box plate inlet and discharge valves.